ENGINEERING NEWS-RECORD

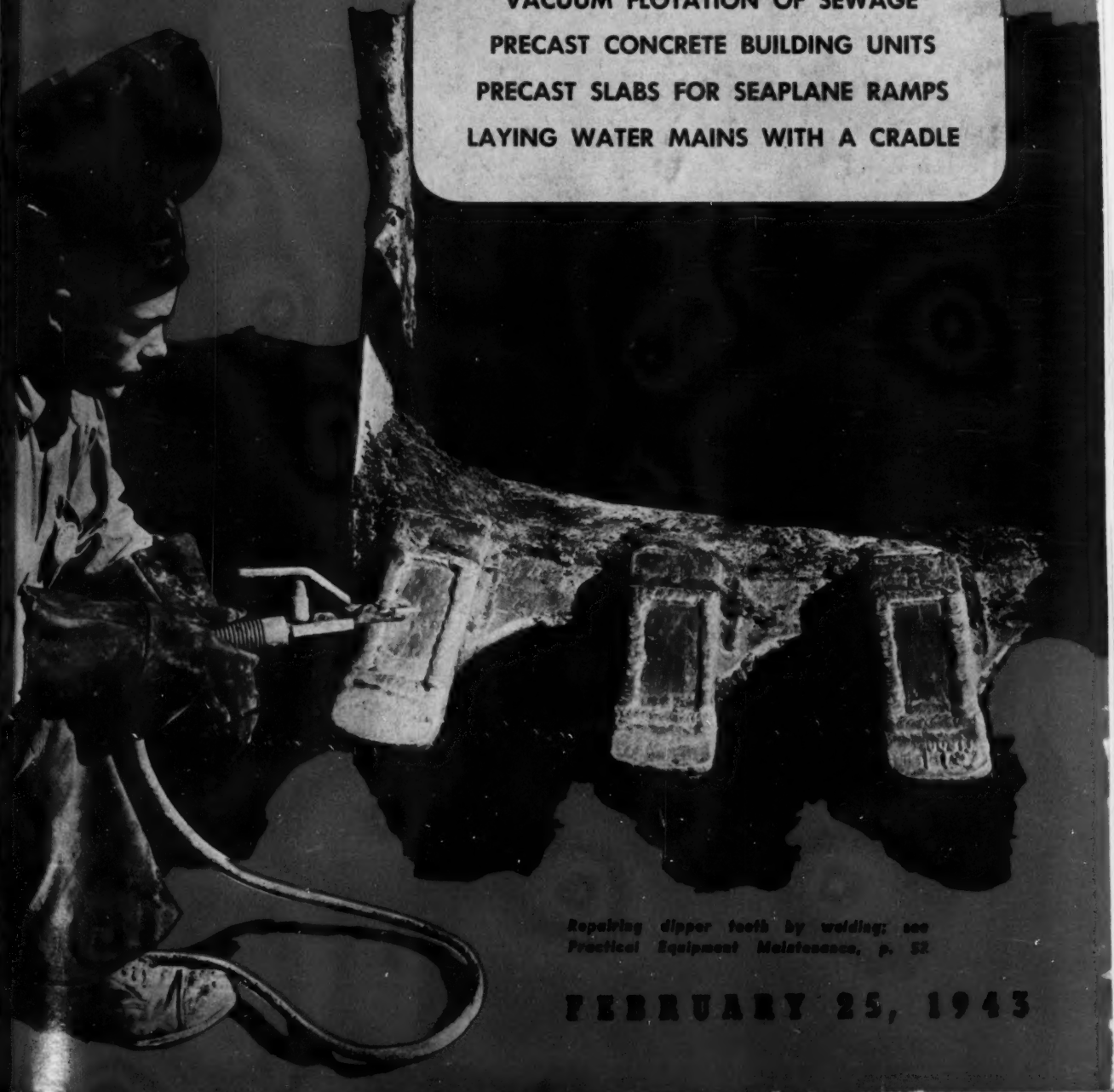
WAR PLANT WITH GLASS WALLS

VACUUM FLOTATION OF SEWAGE

PRECAST CONCRETE BUILDING UNITS

PRECAST SLABS FOR SEAPLANE RAMPS

LAYING WATER MAINS WITH A CRADLE



Repairing dipper teeth by welding; see Practical Equipment Maintenance, p. 52

FEBRUARY 25, 1943

BYERS WROUGHT IRON

convoys this "OVERLAND TANKER"

through the Hot Spots

The Valvoline Oil Company, in replacing a 6-mile stretch of crude-carrying line, used Byers Wrought Iron whenever the piping crossed swampy, corrosive "Hot Spots" . . . and there's an excellent reason.

Wrought iron has been used for half a century or more for applications like this. The first long pipe line in the country was laid from Bradford to Marcus Hook, Pa., 50 years ago, using 4-inch and 5-inch wrought iron pipe. Today the original line between Bradford and Warren is still in use. Other portions, after 29 years at average operating pressures of 1000-lbs. per sq. in., were sold and reused in various parts of the country.

Some of this salvaged pipe was installed in a line crossing the Canadian River near Depew, Okla. In 1926, because of a demand for increased capacity, this line was looped with some 11-year-old pipe of another material. After 8 years, it was necessary to replace the loop. Inspection of the original wrought iron line—then 42 years old—showed it to be still completely serviceable.

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If you have any question on availability or delivery, contact a Byers Field Service Representative, the nearest District Office, or Headquarters in Pittsburgh. You will find this much more satisfactory than depending on hear say reports as to what you can and can't get. Where you select wrought iron as the right material to use . . . and where the government, by its rating, indicates its approval . . . the chances are excellent that we can take care of your needs.

Our General Catalog carries a complete listing and description of Byers products. Would you like a copy?

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Corrosion costs you more than Wrought Iron

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

CONSTRUCTION TRENDS

Notes on significant movements in the construction industry

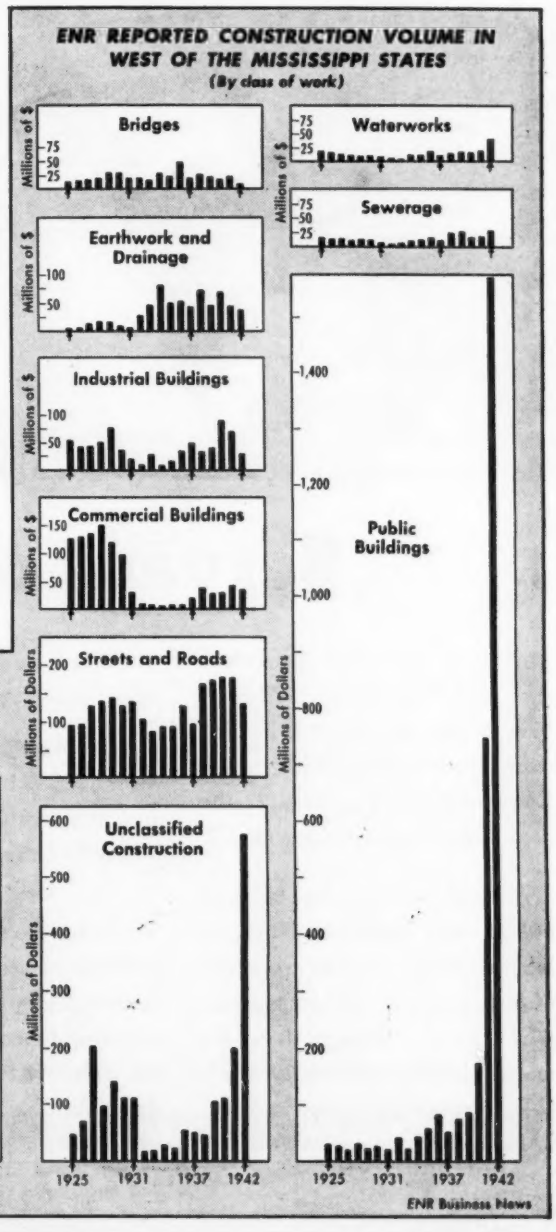
West of Mississippi construction record

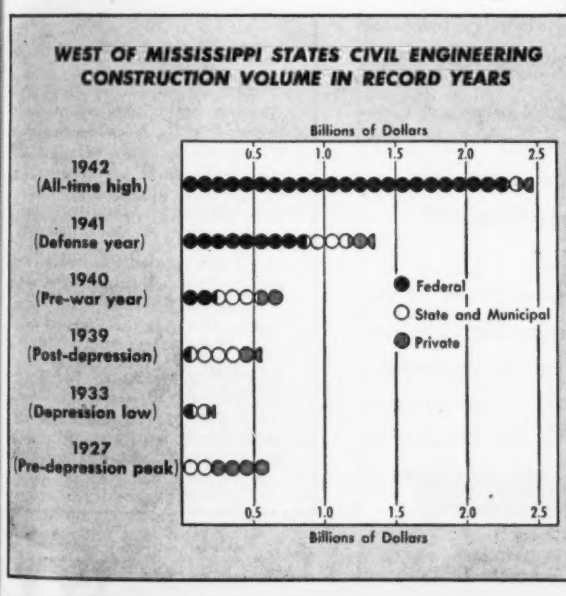
ALMOST 27 percent of the record 1942 United States civil engineering construction was put under way in the fourteen West of the Mississippi states, with the result that the $2,466,930,000 reported for the section eclipsed the defense high of 1941 by 80 percent.

Federal construction, $2,286,992,000, was 93 percent of the region's total and climbed 164 percent over the preceding year's record. Private engineering construction declined to $88,156,000, the lowest volume since 1936, and 48 percent below last year.

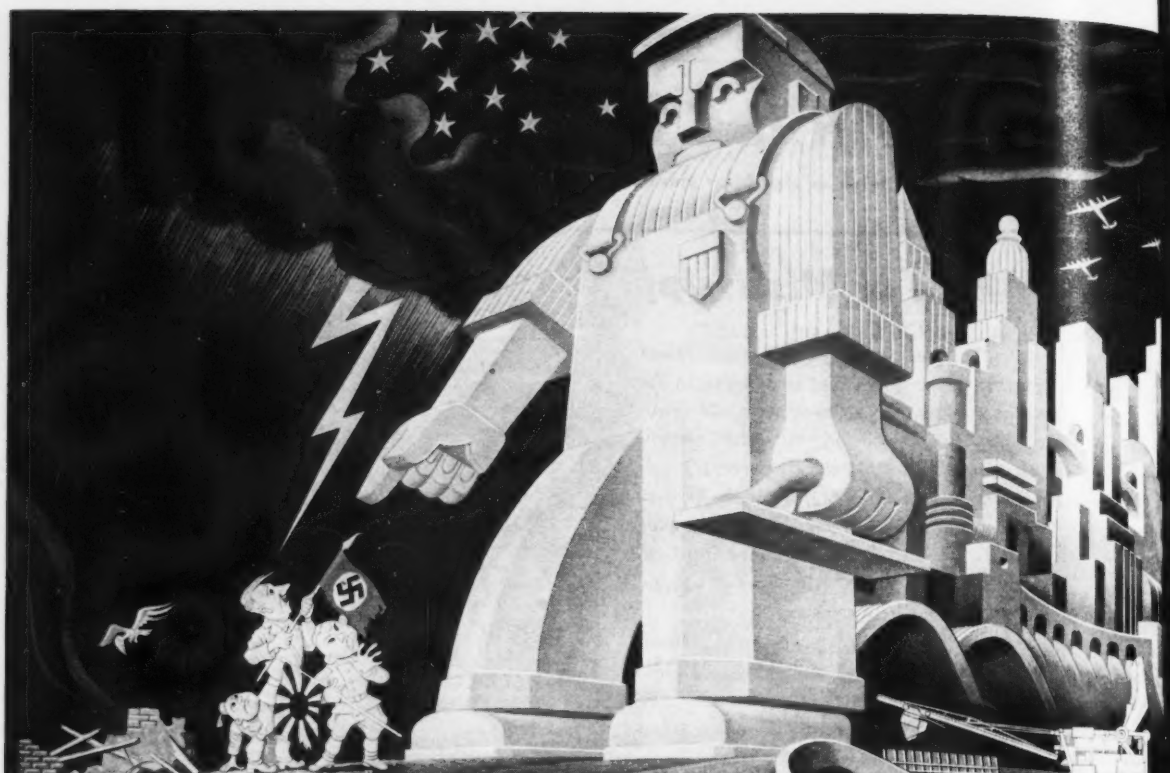
Public buildings, waterworks, sewerage and unclassified construction reached new all-time highs. Public buildings, $1,573,871,000, gained 106 percent and more than doubled the 1941 volume, and unclassified construction, $577,409,000, was 182 percent above its last year's total. Waterworks and sewerage topped their respective 1941 volumes by 105 and 66 percent.

West of Mississippi states opened 1943 with a volume of $65,323,000 for January, a total that exceeded the January 1942 figure by 4 percent, and was 43 percent above the December 1942 volume.





ENGINEERING NEWS-RECORD. Published every Thursday. Return postage guaranteed. Vol. 130, No. 8. Price 25c per copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscriptions, United States, U. S. Possessions and Latin American Republics, $5.00 for one year, $8.00 for two years, $10.00 for three years. Canada $5.50 for one year, $9.00 for two years, $11.00 for three years. Great Britain and British possessions 54 shillings for one year, 108 shillings for three years. All other countries, $9.00 for one year, $18.00 for three years. Entered as second-class matter October 29, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in the U.S.A. Cable Address: "McGrawhill New York." Member A.P.B. Member A.B.C. Copyright 1943 by McGraw-Hill Publishing Company, Inc. James H. McGraw, Founder and Honorary Chairman; James H. McGraw, Jr., President; Howard Ehrlich, Executive Vice-President; Mason Britton, Vice-President; B. R. Putnam, Treasurer; Joseph A. Gerardi, Secretary; J. E. Blackburn, Jr., Circulation Manager. Publication office: 99-129 North Broadway, Albany, N. Y. **Editorial and Executive Offices: 330 West 42nd St., New York.** District Managers and Branch offices: Fred G. Hudson, 520 N. Michigan Ave., Chicago; J. W. Otterson, 68 Post St., San Francisco; Aldwych House, Aldwych, London, W. C. 2, England; Washington; F. M. Spackman, New York; A. B. Cozzens, Philadelphia; E. E. Duff, Jr., Cleveland; B. F. Horn, Detroit; Richard Y. Fuller, St. Louis; R. N. Phelan, Los Angeles; J. I. Ballard, Boston; Ralph Maultsby, Atlanta, Ga.



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Publication Office: 99-129 North Broadway, Albany, N. Y. ● Editorial and Executive Offices: 330 West 42nd Street, New York

JOHN ABBINK, *Publisher*

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Manager*

Vol. 130 FEBRUARY 25, 1943 No. 8

COMING NEXT

• A newly devised system of construction based on the use of vertical, single-wall panel units coupled with assembly procedure utilizing both site and factory fabrication is the most recent development in war housing. Ease of erection, minimum use of critical materials, practically no waste, and flexibility of design are significant results.

• Latest information on operations of the construction equipment pool maintained by the South Atlantic Division, Corps of Engineers, will be published in the Mar. 11 issue. A large variety of machines are now available to contractors on government work. Rental procedure will be explained in detail.

• By the use of formulas recently developed, a direct method of design for eccentrically loaded columns, in place of the trial procedure ordinarily used, is now possible by transposing the column section into a comparable beam section and solving for a beam. Formulas and charts showing procedure will appear in *ENR* for Mar. 11.

• First of two articles to be published on the New Hartford, Conn. bridge, a 3,950-ft. span, with the main river crossing a 270-300-270-ft., three-span, continuous-girder unit, longest in the U. S. Basic design data including details of the 17 ft. deep steel plate girders, and 11½ ft. elsewhere, will be given.

LOOKING AHEAD

• A first hand account of methods and materials employed abroad, especially in Great Britain, in making emergency repairs to water supply, transportation and other public utility facilities as a result of war. This information indicates new time- and labor-saving techniques that may prove exceptionally useful in this country in the event of air raids. To appear in an early issue.

• New ideas in shipyard design for maximum use of prefabricated methods, including outfitting docks 73 ft. wide, whose decks are built up to the level of ship decks with 5 percent grade ramps available for trucks, and many other outstanding features. See *ENR* of Mar. 25.

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Number of copies of this issue printed: 35,773

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Director of Circulation:
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To .....

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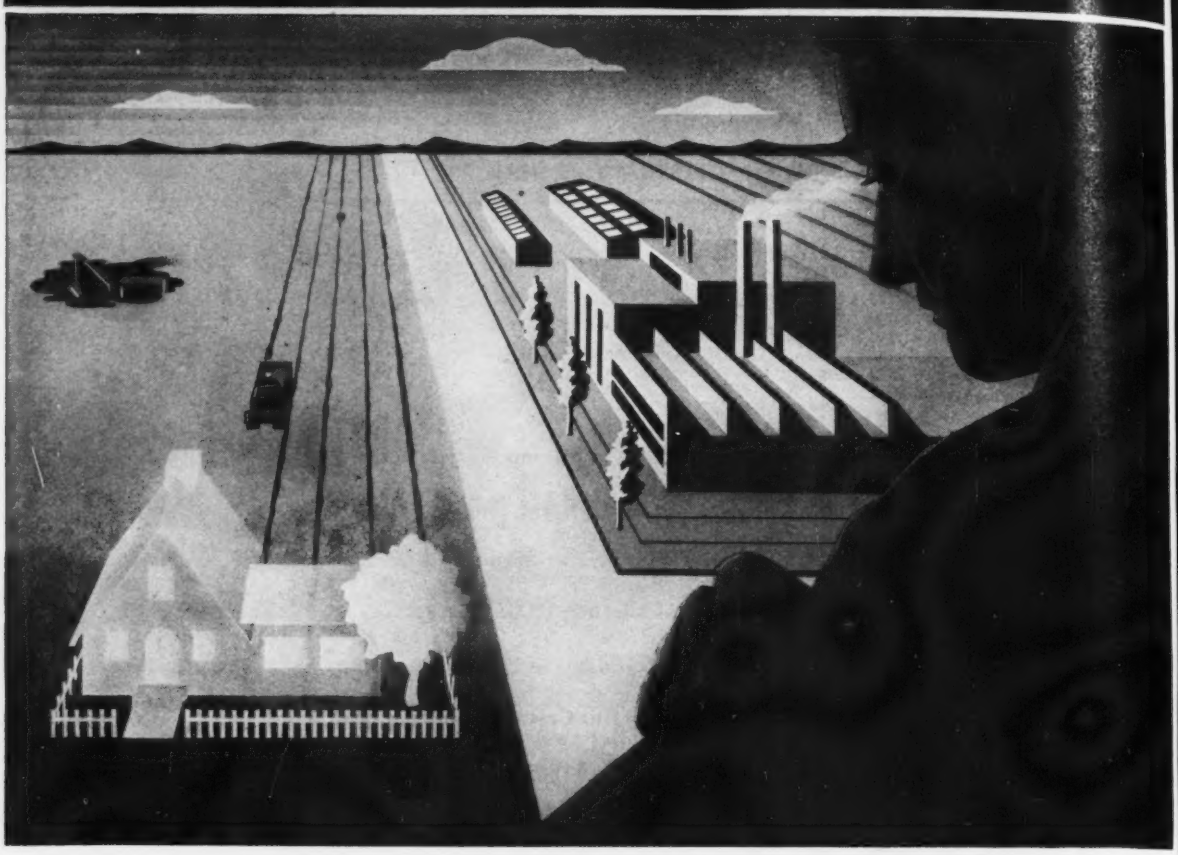
Mr. Chekovski looks at his new home



If this war housing project comprising up to 100 or more houses were in your hands, you probably could complete it faster with Atlas High-Early cement—and save time in wartime.

STAN CHEKOVSKI and thousands of others enrolled in our industrial "army" must have new homes so that war production can be increased in nearby plants. But how soon? Uncle Sam wants war production on the double-quick. New housing for war workers was needed yesterday.

You know an answer to the question. *Atlas High-Early cement.*

Despite cold weather, this speedy cement will help hurry up completion of war housing. This cement has had an important role in helping to place this country on an all-out war basis not only in housing, but in factories, airports, naval bases, cantonments, access roads.

Check the facts in the adjoining box. Use Atlas High-Early cement whenever you need durable, serviceable concrete—*in a hurry*. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

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4. ***Shortens time required for protection and curing*** as much as 70%. This saves fuel and releases tarpaulins and salamanders for other work.
5. ***Reduces overhead*** by saving time, manpower and equipment.

ENR-H-52

SAVE TIME IN WARTIME WITH

Atlas High-Early Cement

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The Week In Engineering and Construction

NGINEERING NEWS-RECORD • FEBRUARY 25, 1943 • VOLUME 130 • NUMBER 8

Reinforcing bar restrictions relaxed on construction

Steel bars are now permitted in many types of structures required by war effort or in those that will have a useful purpose after the war.

A limited relaxation of restrictions on e use of concrete reinforcing bars, hich were put into effect some months go, was announced last Thursday by the nservation division of the War Produc- n Board. These restrictions take the rm of instructions issued by the con- rvation division for the guidance of all PB agencies concerned with the use critical construction materials.

As a result of the change, steel rein- rcement bars will now be permitted in ny types of structures, if it can defi- tely be shown that the war effort will ereby be better served or protected, rticularly against fire hazards or botage, and in construction which may rve a useful purpose after the war.

When reinforcing steel is permitted for ilding construction the applicant will required to submit a certificate to the fect that the reinforcing steel design is will be in accordance with the War oduction Board national emergency ecifications for the design of reinforced ncrete buildings.

Will affect lumber needs

Although increased use of reinforce- ent bars will create a larger demand r concrete form lumber, the move is pected to ease the pressure on supplies other materials, such as structural mber, which have been widely substi- ted for steel.

Officials of the steel division and the nservation division pointed out that e military construction programs have w passed their peaks, thus consider- bly easing the total demands for rein- rcing bars. Because of the reduced emands, the steel division recently con- ntrated the production of reinforce- ent bars in old rail re-rolling mills, us releasing the facilities of many rein- rcement steel producers for more rgently needed steel products.

Under the concentration program, re- nforcement bars are produced (with the ception of some special sizes and speci- fications) in re-rolling mills, whose facilities cannot be fully employed for other purposes. These mills use scrap material such as old railroad rails.

Permitted uses

These factors now permit the relaxation of restrictions established when demand for reinforcing bars was much larger. Reinforced concrete may now be used, the conservation division said, in the following types of structures (when they are approved as essential

(*Continued on p* 36)

Dean Potter to be given 1943 Washington Award

Andrey A. Potter dean of engineering at Purdue University and chairman of the National Advisory Committee on Engineering and War Training, has been given the Washington Award of 1943, E. Gordon Fox, chairman of the award commission for the Western Society of Engineers, announced last week.

The award, founded in 1916 is made annually on or about Washington's birthday, to an engineer "on account of accomplishments which preeminently promote the happiness, comfort and well being of humanity." Previous recipients include former President Hoover.

The honor is given to Dean Potter for "distinguished leadership in engineering education and research and patriotic service in mobilizing technical knowledge for victory in war and peace."

Price ceiling changes expected soon

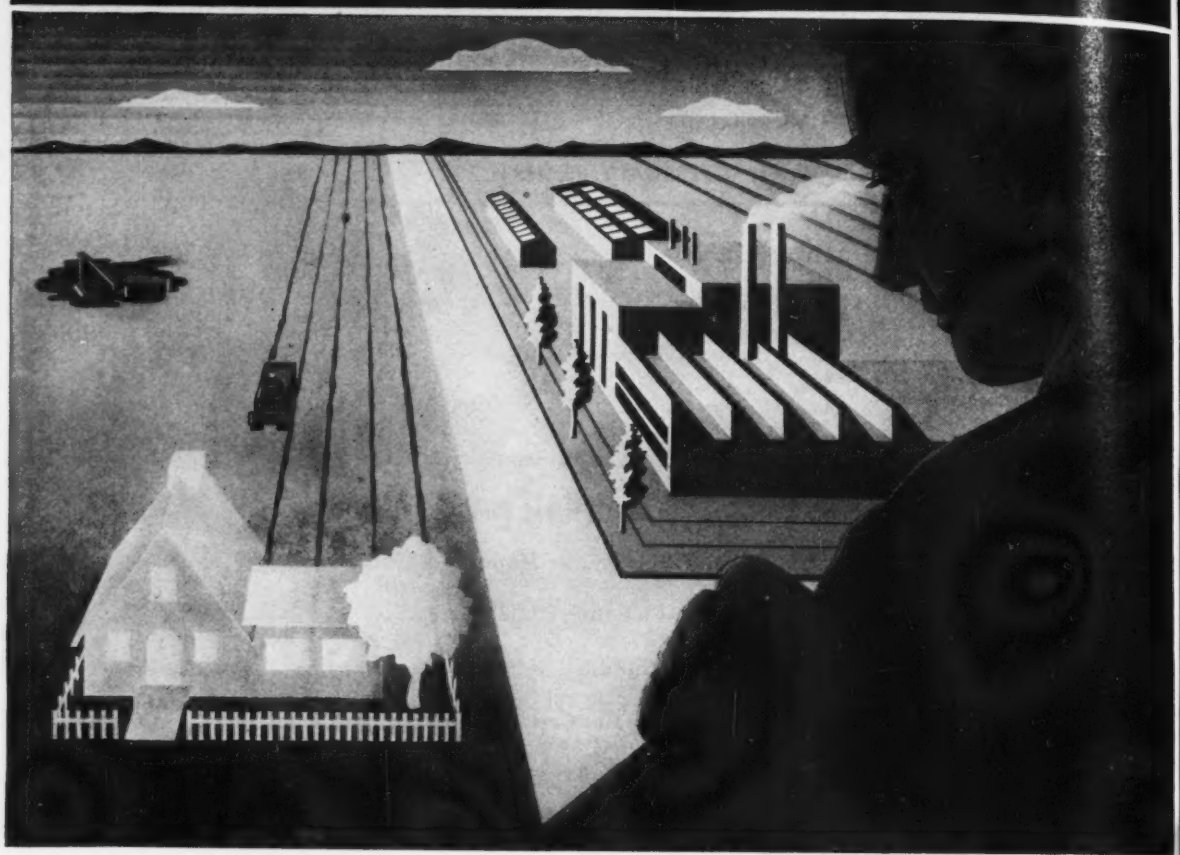
Long-pending amendments to the construction price ceiling order—Regulation 251—will probably be issued this week or next. In preparation since November (*ENR*,Nov.26'42,p.737), the amendments have been expected momentarily since early this year. This time, however, it looks like business.

In addition to various technical clarifications, the amendments will make two rather important changes. One will make the wage provisions more flexible. Regulation 251, which bases ceiling price on cost or cost estimates plus a markup, now requires that labor cost be figured as of the wage rates in effect last July 1. This date was picked because wage rates on federal construction had been stabilized by agreement as of that date. The rule, however, could cause difficulty as to nonfederal jobs, on which wages were not stabilized until the President's general wage stabilization order of Oct. 3 was issued. Moreover, no means was provided, except the clumsy process of amendment of the regulation, for adjusting prices to reflect wage increases approved by federal wage-adjustment agencies.

The pending amendment is expected to require that labor costs be figured at wage rates as of Oct. 3 plus any increases which may have been approved by a competent agency such as the War Labor Board or the Labor Department's Wage Adjustment Board.

At present, Regulation 251 requires contractors on fixed-price contracts to report to the OPA the estimated costs on which they base their price and then, ten days before final payment under contract, to report the actual costs. One of the pending amendments will change this to require the final report ten days *after* final payment. This is a technical improvement, in that it is often difficult to know in advance when a contract will be settled finally. More importantly, it will ease the fears which many contractors have expressed that the regulation would require them to refund any excess of estimated over actual costs. OPA officials have insisted from the first that there was no such intent in the regulation, but contractors have remained suspicious. Also they have feared that, although the report is supposed to be confidential, project owners would get a look at it and use it to force down the price.

Mr. Chekovski looks at his new home



If this war housing project com

probably could complete it fast

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HTLY

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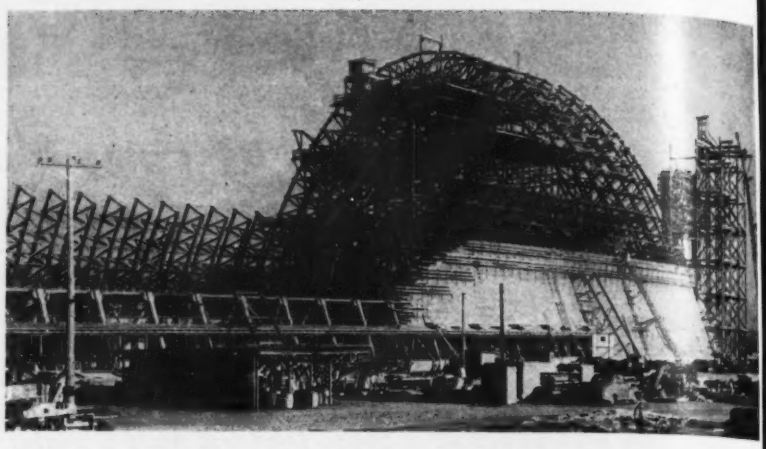
Winds wreck wood arches of partly erected hanger

Information has just become available concerning erection damage sustained by one of the Navy's huge timber blimp hangars in two recent windstorms spaced about three weeks apart. The first storm, on Jan. 23, a continuing gale of 85 m.p.h., with gusts of even higher velocity, blew down the central portion of all nine arches that had been erected and of a tenth that had been partly erected. The second storm, a sudden swirling wind of only a few minutes duration on Feb. 11, moved the falsework, which was mounted on railroad trucks, pulling down three completed arches as well as wrecking the lower ends of several more on which the closing central portions had not been set. Both collapses are classed as erection accidents, and are said to imply no basic fault in the hangar design. At the same time, persons familiar with the timber hangar program are said to believe that the accidents may cause some changes in erection procedure on a number of the jobs now underway.

The hangar, of a type described in *Engineering News-Record* Oct. 22, 1942, p. 576, is of unprecedented size for a timber structure, consisting of some fifty spandrel-braced arch ribs of 246 ft. span and 133 ft. rise mounted on 24 ft. high A-frame bents of reinforced concrete. The erection procedure being followed involved placing each rib in three sections—the six bottom panels at either side as cantilevers about 60 ft. long and a central fill-in section of 14 panels. Cranes on the ground erected the cantilevers while a high falsework tower mounted on railroad trucks was moved through the structure to set the fill-in sections. At the time of the first storm all of the cantilever sections were in place, nine arches were complete and work had started on the central section of the tenth arch.

Inasmuch as this storm struck at 1 a.m. witnesses could not see the sequence of the collapse. However, it is known that the bracing between the arches was incomplete, only that in the plane of the bottom chords having been installed over the central portion of the arches. Also some of the two-bolt connections of this bracing to the arches may have had only one bolt, as the hole for the second bolt was to have been bored in the field. The central portions of the arches were, therefore, far from rigid. In the lower ends of the arches, however, bracing had been installed and some of the roofing was in place. None of these ends collapsed.

The debris of this first collapse had been cleared away, and three of the arches had been rebuilt when the second storm struck nearly three weeks later. Cause of the damage sustained in this storm apparently rests in the fact that the railroad trucks supporting the central falsework were not blocked against movement. The wind rolled the falsework down its tracks, dropping the three arches, and this time pulling down some of the cantilever ends as scaffolding and guys were fouled by the moving falsework. In neither of the storms were the concrete A-frames damaged.



Official U. S. Navy photo

Erection under way (above) on 246-ft. span, 170-ft. high timber arches for blimp hangar; and (below) debris after some of arches had fallen due to high wind.

Consequences of the two accidents, it is said, will be to place more emphasis on quick installation of adequate bracing, making each arch rib secure before moving on to the next one. It may also be that roof sheathing will be speeded up so that wind loads will be distributed among a number of arches as will be the case in the completed hangars.

It should be pointed out, however, that similar storms of lower intensity have occured at each of two other Naval lighter than air stations at which similar hangars were under construction. In both cases ribs supported only by guy lines and temporary bracing were up. Although the wind storms were severe, no damage occurred to any of the hangars, and as soon as the storm was over, construction proceeded.

• • •

Appoint N.Y.U. research laboratory director

Philip Goldsmith, formerly sanitary engineer in the department of public works of the City of New York, has been appointed acting director of the Sanitary Engineering Research Laboratory at New York University's College of Engineering, replacing Dr. Rolf Eliassen, who is on leave of absence while serving as a major in the U. S. Army.

In addition to the research activities of the sanitary engineers at the college, laboratory courses in sanitary chemistry are going forward under the direction of Robert Ingols, sanitary chemist of the Hackensack (N. J.) sewage treatment plant. Undergraduate courses in sanitary engineering are being conducted by Arthur H. Herberger and Charles M. Gard

Nothing to fear in renegotiation, Loving tells A.G.C. members at meeting

Price adjustment chief heard at short convention session in Chicago; labor, maximum price regulations and postwar planning considered

Renegotiation implies no blame, moral turpitude, carelessness or negligence on the part of the contractor, Harry W. Loving, chief of the price adjustment section, Corps of Engineers, declared in a talk at the annual convention of the Associated General Contractors of America in Chicago last week. Therefore, he pointed out, contractors should have no fear of being investigated under the price adjustment act, especially as it is to their interest to remove any possible taint of profiteering in war contracts.

Harry W. Loving

Renegotiation, Loving said, is not a punitive expedition into private enterprise, nor is it a collection drive, it is rather an investigation into the costs of our colossal war program for the purpose of seeing that no one makes excessive profits. Estimates on war contracts, he said; often had to be made with insufficient information, with lack of time to prepare proper figures and in the face of many unknown factors, all of which in some cases resulted in too large a profit to the contractor.

Voluntary renegotiations have already returned over one billion dollars to the government, Loving added, and many more voluntary offers are yet to be considered. In answer to many questions, he declared that the excess profits tax does not take care of the situation because taxes are collected too long after contract payments are made, and thus time is available for the money to exert an inflationary effect. Renegotiation encourages conservation in spending of money, taxation does not, he explained. Renegotiation does not penalize the efficient contractor, Loving declared, as the board has been instructed to take efficiency and ingenuity into consideration. The act, therefore, does not reduce all contractors, good and bad, to the same level as has been frequently charged.

Convention a short session

Acceding to the request of ODT to reduce travel, the A.G.C. shortened its usual four-day full convention to a two-day meeting of the executive board and board of direction, attended only by officers, staff members, managers, secretaries and a few members. All social functions were eliminated. The program, however, was crowded with discussions of the major problems besetting contract operations under wartime conditions. These included labor relations, Maximum Price Regulation 251, market development and postwar planning.

Labor discussions centered around restrictions that prevent increases in wages and salaries and the difficulties in holding certain classes of labor in the face of competition from other industries. Many technical questions were raised, some of which went unanswered because of lack of rulings that might apply, though Jim Marshall, A.G.C. labor secretary, offered sound counsel in most cases.

Postwar planning

Postwar planning came in for serious consideration several times, most prominently in a report on market development presented by S. M. Siesel of Milwaukee. His report pointed out that the real market for contractors lies in postwar projects, and it urged cooperation on the part of contractors in assisting those charged with such planning. The report named several large public-works agencies that have already set up postwar programs, such as the Bureau of Reclamation, Public Roads Administration, Federal Works Administration, Civil Aeronautics Authority, and the various state highway departments. As the construction industry will be used in some capacity in all plans now being made, the contracting element of that industry should be in on the planning.

A furore arose with respect to Minimum Price Regulation 251, not so much against the idea of keeping prices down, but in view of the impracticability of administering the regulation as it now stands. The convention was told that in all probability the regulation will be amended, modified or abolished shortly.

Construction and the war

In his annual report to the convention H. E. Foreman, managing director of the association, stated: "The construction industry has passed through the year of its greatest and most vital activity in which it performed the construction work that is the foundation of the nation's drive to victory. By its accomplishments of the past year, the industry has demonstrated clearly its ability to carry out with speed the declining volume of war construction needed for the duration. The future of the industry, and the nation, is impossible to predict. The heavy fighting of the war, the heavy sacrifices in human lives and resources, has not yet started for this country. A somber prospect is that complete victory may strip the nation of its resources. The planning of activities of the association and of individual member organizations must take into account conditions as they now exist and as they will be in the near future." The report reviewed that part construction has taken in the preparation for war, and the many

Leaders of the Associated General Contractors for 1943 snapped at the Chicago meeting. They are, left to right: H. E. Foreman, managing director, Oscar B. Coblentz, president, and Wm. Muirhead, vice-president.

problems faced by contractors carrying out the war program.

Change in name proposed

Many other topics were discussed, including the changing of the association name to Associated General *Constructors* of America as every firm now doing work for or making supplies for the government is known as a contractor. The matter was tabled for further consideration at the next meeting. Accident prevention awards were made by Glen Maxon, chairman of the accident prevention committee. Leo Richardson made a report for the public relations committee, which included a discussion of the current radio broadcast series made available to every branch and chapter.

About 30 chapter secretaries and branch managers met the day preceding the convention to discuss chapter problems. Robert J. Hendershott, Minneapolis, was named chairman of the secretaries and managers council for the coming year; Roy A. MacGregor, Pittsburgh, was named vice-chairman; Frank Connor, Charlotte, N. C., secretary.

New officers installed

The association installed new officers for the current year, including Oscar B. Coblentz, Baltimore, Md., as president, and Wm. Muirhead, Durham, N. C., as vice-president. Division chairmen and vice-chairmen were named as follows: Highway, W. P. Roscoe, Billings, Mont., and D. W. Winkelman, Syracuse, N. Y.; Building, Paul Fogel, Kansas City, Mo., and Ford Twaits, Los Angeles, Calif.; Heavy Construction, A. Teichert, Jr., Sacramento, Calif., and C. A. Lott, Pittsburgh, Pa.

The place and date of the next meeting were left for determination by the executive board.

• • •

Overseas construction tops 2 billion in 1942

By finding construction material overseas during 1942, many thousand tons of merchant shipping were freed for use in transporting food and munitions, the War Production Board said last week in a report that the overseas construction program for 1942 amounted to about two billion dollars.

The construction program comprised camps, fortifications, harbor installations, storage facilities, repair shops, airfields and other types of facilities needed to service the American expeditionary forces. The total does not, however, include the cost of maintenance and subsistence of the troops engaged in construction work, or the cost of shipping the materials that could not be provided from local sources.

"By thoroughly combing the materials market abroad, the agencies responsible for construction not only reduced shipping space requirements, but speeded the work," the WPB said. "One case in this connection occurred in the Far East where thousands of tons of cement were needed. When it was discovered that a large cement mill capacity existed in this area and that the country had an exportable surplus, orders for American cement were cancelled by engineers in charge and the equivalent of one 10,000-ton vessel for a year was saved for use in other pursuits.

"Another instance occurred in an Eastern Mediterranean country from which construction agents were sending orders for asphalt roofing. An investigation showed that the country produced large quantities of tile, as well as various types of masonry and clay products and that natives had been making satisfactory roofs out of these materials for centuries. Local materials were adopted and the necessity for shipping asphalt roofing halfway around the world was eliminated."

A policy of using local materials wherever possible in construction of the Pan American Highway has produced valuable results, WPB said. One notable achievement occurred in connection with the steel needed for bridges and culverts of the highway. Second-hand and scrap steel found chiefly in Mexico accounted for about 29,000 of the 30,000 tons of steel required. The remaining 1,000 tons was processed in the United States, since this was required for specially fabricated bridge ties and other uses which called for a fine degree of accuracy in fabrication.

Aided Pacific victory

An example of how the speedy work of construction was a major factor in the recent victory by the U. S. Marines and Army folk in their conquest of Guadalcanal, in the Solomon Islands, was contained in recent despatches from the war area.

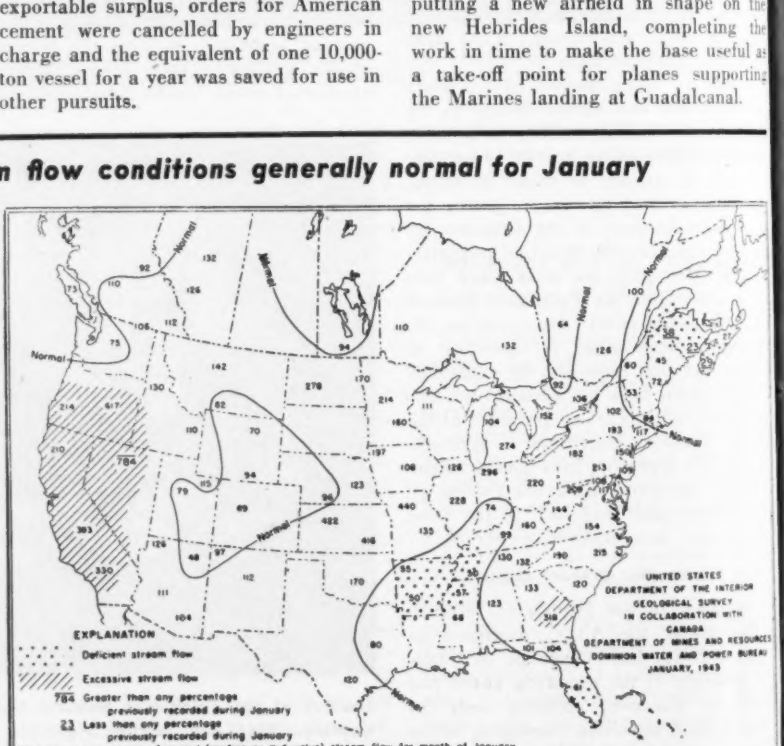
Construction men were given credit for putting a new airfield in shape on the new Hebrides Island, completing the work in time to make the base useful as a take-off point for planes supporting the Marines landing at Guadalcanal.

Report shows steam flow conditions generally normal for January

The general favorable country-wide pattern of ground-water conditions that existed in December continued through January, except in local areas, according to the monthly report issued jointly by American and Canadian government agencies.

The report noted unusual currents and floods along the Pacific coast, continuation of rather severe winter drought conditions in Nova Scotia, New Brunswick, Canada, and Northern Maine; improvements of stream flow in the Rocky Mountain area; and enlargement of the area of subnormal stream flow in the South Central States, as indicated on the adjoining map.

Stream flow in major power producing areas of the United States and Canada was above normal during the month excepting in the Maritime Provinces and Southeastern Quebec, Canada, Northern New England and Washington.


Normal
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
IN COLLABORATION WITH
CANADA
DEPARTMENT OF MINES AND RESOURCES
DOMINION WATER AND POWER BUREAU
JANUARY, 1943
EXPLANATION
Deficient stream flow
Excessive stream flow
784 Greater than any percentage previously recorded during January
23 Less than any percentage previously recorded during January
All numbers are percent of normal (median or mid-value) stream flow for month of January

Concrete Institute meets in token convention

The 39th convention of the American Concrete Institute held in Chicago, Feb. 17, will go down in the annals as the smallest annual meeting that this organization ever held. It was referred to as a "token" convention by Prof. M. O. Withey, president-elect, during his remarks at a luncheon, the only session other than those attended by the board of directors. It was an apt phrase, as the plans for a regular-size convention were scrapped only a month prior to the date of the meeting.

Despite the small attendance, about 100, several important pieces of business were transacted. Outstanding was the award of prizes, Rear Admiral Ben Morell, chief, Bureau of Yards and Docks, being given the Turner Gold Medal "for notable leadership in concrete design and construction for the U. S. Navy in peace and war": Capt. Hugo C. Fischer (CEC) USN being awarded the Wason Medal for his paper on architectural concrete for the Naval hospital at Bethesda, Md., and the ship model testing basin at Carderock, Md.; and M. A. Swayze, research director, Lone Star Cement Corp., being given the Wason Research Medal for his report on concrete curing.

In addition to Prof. Withey, the new president, election of Roy W. Crum and Douglas E. Parsons as vice presidents was announced. The following directors were also elected, John R. Nichols; A. Burton Cohen; Fred Hubbard; P. J. Freeman; H. F. Gonnerman; T. E. Stanton; and Stanton Walker. The retiring president, Prof. Raymond E. Davis of the University of California, was unable to attend the meeting because of illness.

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Mud Mountain dam cost set at $11,000,000

Actual cost of the Mud Mountain flood control dam near Seattle, Wash., was more than double contract estimates, Col. Richard Park, Seattle district engineer has revealed.

The original contract with the Guy F. Atkinson Co. of San Francisco, set the cost at about $5,344,605, but final figures showed the cost at $11,000,000 due to design changes. The structure is now complete except for installation of temporary control valves.

Original plans called for an earthfill structure but these plans had to be changed to specify a rockfill dam when it was found that clay content in the earth to be used was extremely sensitive to moisture, making compaction difficult.

JOBS OF THE WEEK

HOUSING, Washington
Seattle Housing Authority, Seattle, received lowest bid from Nettleton & Baldwin, Seattle, for housing units at $1,215,000. Jones, Bain, Thiry & Shay, Seattle, are architects.

PLANT, Indiana
An industrial company awarded contract on reconditioning plant to Albert J. Glaser, Anderson and Muncie. Estimated cost $4,000,000. Defense Plant Corp. will finance.

HOUSING, New York
Public Housing Authority, 270 Broadway, New York, has awarded contract for constructing housing units to Chain Construction Co., New York, N. Y., at cost of $1,109,000. Niagara Falls Associated Architects, Niagara Falls, are architects.

RUNWAYS, etc., California
U. S. Engineer, Sacramento, Calif., awarded contract for runways, and facilities, Contra Costa County to Piazza & Huntley, Larson Bros. and Harms Bros., Sacramento, Calif., estimated cost $500,000–$1,000,000.

HOUSING, Delaware
Public Housing Authority, Washington, D. C. received lowest bid on Shipside Housing Project Extension for Wilmington Housing, Wilmington, Del., from M. Shapiro & Son Construction Co. Inc., Philadelphia, Pa. Project cost is $1,226,700. G. Morris Whiteside II, Wilmington, Del. is architect.

HOUSING, Kansas
Public Housing Authority, Kansas City, Mo., awarded contract for housing projects to J. E. Dunn Construction Co., Kansas City, Mo. Cost is $1,612,177. Marshall & Brown, Kansas City, Mo. are architects.

PLANT, Indiana
Wermuth, Inc., Fort Wayne, Ind., received contract from an industrial company for plant addition. Estimated cost is $1,700,000. Defense Plant Corp. will finance.

RESIDENCES, Ambridge, Pa.
Shaler Building Co. care Housing Mortgage Corp., Pittsburgh, Pa., let contract for 189 residences to Keystone Associates, Pittsburgh, Pa. Estimated cost $830,000.

IMPROVEMENTS, New Mexico
U. S. Engineers, Albuquerque, N. M. has let contract for improvements in Lea Co. to Skousen Brothers, Albuquerque. Estimated cost is under $1,000,000.

PLANT, Joliet, Ill.
American Steel & Wire Co., Chicago, Ill., awarded contract for rod mill addition to Sumner S. Sollitt Co., Chicago, Ill. Total estimated cost $15,000,000.

IMPROVEMENTS, Idaho
U. S. Engineers, Portland, Ore., awarded contract for improvements to Ertz-Burns, D. M. Drake, Lorenz Brothers, and Parker-Schram Co., Portland, Ore.; electrical distribution system to Walton & Brown Elec. Co., Salem, Ore. Total estimated cost $2,500,000.

AVIATION FACILITIES, Glenview, Ill.
Bureau of Yards & Docks, Navy Dept., Wash. D. C. aviation facilities at Naval Reserve Aviation Base. Contract awarded to Standard Paving Co., White Consolidated Inc., and Midwest Construction and Asphalt Co., Chicago, Ill., at cost of $1,670,000.

Note—Additional bidding and contract news on many projects large and small appear in the Construction News section beginning on page 113.

WPB halts construction of tin recovery plants

Continuing its policy of halting construction projects in order to bring the 1943 construction picture into focus with war needs, the War Production Board last week halted construction and ordered revocation of priority ratings on ten detinning and recovery plant projects. Total cost of the plants would have exceeded $12,000,000.

The plants were to have been built in New York, Chicago, Los Angeles, Dallas, Buffalo, Baltimore, Birmingham, Pittsburgh and Seawaren, N. J. Priority orders had been issued to the H. K. Ferguson Co., as builder of nine plants, and the Vulcan Detinning Co., of Seawaren.

Postponement of construction does not indicate improvement in the scrap situation, WPB said, but indicates rather that equipment scheduled to be put in the plants is more urgently needed elsewhere.

War restrictions relaxed on reinforcing bars

(*Continued from p* 31)

to the war effort) and for the following miscellaneous purposes:

Class A. "Duration" construction, namely, for use only during the war emergency.

1. Industrial and military
   a. All types where it can definitely be shown that by its use the war effort will be better served or protected, particularly against fire hazards and sabotage.
2. General.
   a. Foundations, including footings except under some conditions.
   b. Grade beams and lintels.
   c. Retaining walls and bulkheads, except where gravity types are practicable.
   d. Precast concrete piles.
   e. For resistance to hurricanes and earthquake shocks.
   f. Pressure pipe.
   g. Sewer pipe over 24 inches in diameter.
   h. Manhole rings and covers.
   i. Tanks.
   j. Bridge superstructures, where alternate non-metallic materials are not available.
   k. Airport runways and flight strips.
   l. Slabs over boiler rooms with occupied spaces immediately above.

Class B. Construction that may serve a useful purpose after the war.

1. Public utility construction (including but not limited to power houses, waterworks and sewage disposal plants.)
2. Hospitals.
   a. U. S. Veterans Bureau.
   b. Additions to existing fireproof structures.
   *c. Two stories high and capacity of more than 50 beds.
   d. Three stories or more high.
3. Industrial.
   a. Additions to existing fireproof structures.
   b. Boiler houses and where high temperature operations are to be carried on.
   c. Warehouses for storage of vital or critical commodities such as finished products or parts, those of high strategic value or of a flammable nature.
   d. Plant offices two stories high. (Concrete roof framing and slabs excepted.)
   e. Plant offices three stories or more.
   f. Plant offices where important records, drawings, etc., are housed, and vaults, cabinets, etc. will not fully protect them.
4. Schools.
   a. Additions to existing fireproof structures.
   *b. Two stories or more high.
5. Dwellings.
   *a. Multi-family (three or more families with joint facilities or services or both) three stories high.
6. General.
   a. Access and strategic network roads, including their bridges.
   b. Culverts, where non-metallic materials are not adequate or available.
   c. Wharves and piers (For wharf houses see Warehouses).
   d. Bridges.
   e. All items under ClassA-2 General —except item (j).

For the items in the above list marked (*), reinforced concrete is limited (other than as permitted by Class B. General) to columns, first floor slabs, fire stairs and public corridors above first floor.

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Indiana asks increase in highway bureau budget

The Indiana State Highway Commission has asked the legislature for $11,000,000 more for the next biennium than the present budget provides, in order to maintain the state's roads fit for wartime travel.

The budget requests a total of $19,000,000 for the next two years and includes a clause that would give the department additional funds if revenues should exceed estimates.

However, the department estimates that its receipts from gasoline taxes will be about $15,500,000 for 1943, as compared to $26,000,000 in 1942. Other tax revenues are expected to drop proportionately.

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First "Big Inch" oil deliveries received

Although no tank cars were available until last week to receive it, the first oil flowed into Norris City, Ill. Feb. 13 through the 24-in. pipeline from Texas.

The first flow began at 2:10 p.m., Feb. 13, at the rate of 60,000 bbl. daily. Capacity of the line is 300,000 bbl. daily, a figure expected to be attained in April.

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Contractor takes over shipbuilding yards

The J. A. Jones Construction Co. of Charlotte, N. C. has taken over the Brunswick Marine Construction Corp.'s South Yard, at Brunswick, Ga., where 30 Liberty freighters are to be built for the U. S. Maritime Commission. The yard has six ways and an outfitting dock, covers 480 acres and is laid out for straight-line prefabrication and assembly of ships.

The Jones firm have been general contractors for years and have only recently gone into ship construction. At their Wainwright yard in Panama City, Fla., they are constructing 33 Liberty ships.

The Brunswick Marine Construction Corp. will continue operation of their North Yard at Brunswick where tugs and tankers are being built for the Navy.

Railroad plans 15 million improvement program

The Central of Georgia Railway, in receivership for the last 20 years, is embarking on a $15,000,000 rehabilitation program that will extend over the next five years, officials of the road said at Atlanta, Ga., recently.

The program was approved in the U. S. district court at Savannah previously with approval of a five man committee to act in an advisory capacity in the reorganization of the road.

Improvements contemplated under the program include laying of 15,000 tons of rails during each of the five years; installation of an automatic block traffic control system between Macon and Forsyth; extension of the telephone system; purchase of five diesel and eight steam locomotives; purchase of 10 passenger coaches, six express cars, two baggage and mail cars, 1,550 box cars and other rolling stock.

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Tacoma to investigate cost of power job

The Tacoma, Wash., city council has authorized Mayor Harry P. Cain and Works Commissioner A. R. Bergersen to submit a list of engineers from which the council may select a man to make an examination and audit of engineering estimates and costs on the city's second Nisqually power development.

The decision to make an investigation followed a request by utilities commissioner R. D. O'Neil for authority to increase expenditures on the project by about $3,500,000 to bring total cost to an estimated $17,508,085.

Cost of the project when initiated two years ago was estimated at $11,000,000. Before contracts were awarded in the first half of 1942, however, the total was increased to $14,000,000 because of higher wages and material costs. The main contract, calling for construction of the Alder dam, powerhouse and spillway and the LaGrande dam and spillway, was awarded to the L. E. Dixon Co. of Los Angeles, Calif., for $5,964,384; with a $1,604,218 tunnel contract let to the West Construction Co. of Brookline, Mass. Still another contract for $298,071 was awarded to the J. F. Shea Co., and General Construction Co. of Seattle, for a second powerhouse. Other contracts were let for rail relocation and for dam and powerhouse equipment.

Commissioner O'Neil, in asking authority to increase expenditures, said variance in the figures was due to errors and misjudgment on the part of the engineers.

OBITUARY

George D. Price, civil engineer with the War Department, died suddenly last month. Mr. Price was stationed at Fort Jackson, S. C. He was a graduate of Clemson College.

Egerton Swartwout, outstanding American architect, died Feb. 19, in New York City. Besides being a brilliant designer, Mr. Swartwout was active for many years in perfecting the code of competition of the American Institute of Architects. He was a graduate of Yale University in the class of 1891. Among the outstanding buildings which he designed are the following: Missouri State Capitol, new section of the Museum of Fine Arts at Yale, and the Elks National Memorial in Chicago.

Thomas MacDonald, 71, chief engineer, Aspinwall, (Pa.) pumping station, died the past week. Mr. MacDonald had been employed by the city of Pittsburgh for almost 45 years. He was killed suddenly when a train struck his automobile.

Oliver Perry Petty, 72, for the past 18 years engaged in the construction business at Atlanta, Ga., died Feb. 5.

Homer F. Smith, 53, who, for 35 years, was a construction superintendent at Atlanta, Ga., died the past week.

Charles Morton, 77, a building contractor, died at Larchmont, N. Y., Feb. 6. Mr. Morton was one of the contractors who built Columbia University, New York, N. Y.

Frank Bell Green, 77, civil engineer, died Feb. 8 at New York, N. Y.

Patrick T. Cox, 75, president of the P. T. Cox Construction Co., Inc., New York, N. Y., died Feb. 13 at Douglaston, L. I. Mr. Cox's firm had just received a Navy E production pennant for excellent work at the naval torpedo station, Newport, R. I.

Morton Leffingwell Fouquet, 74, retired civil engineer of Palm Beach, Fla., and New York, N. Y., died at Palm Beach on Feb. 16.

Robert Abernethy, pioneer building contractor in British Columbia, died at Vancouver recently. He was 70 years old.

William A. Kinsman, retired building contractor, died Feb. 12 at Newburgh, N. Y.

Jesse C. Cook, 53, chief engineer of the American Creosoting Co., died last week at his home in Jeffersonville, Ky. He was a graduate of Purdue University.

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Connecticut checks effect of gas rationing on bridge

Governor Raymond E. Baldwin of Connecticut has ordered a traffic survey to determine how much gas rationing has cut travel over the Groton-New London highway bridge. The information is to be used to determine if a deficit will result from the proposed toll rate when the new bridge over the Thames River is officially opened for traffic.

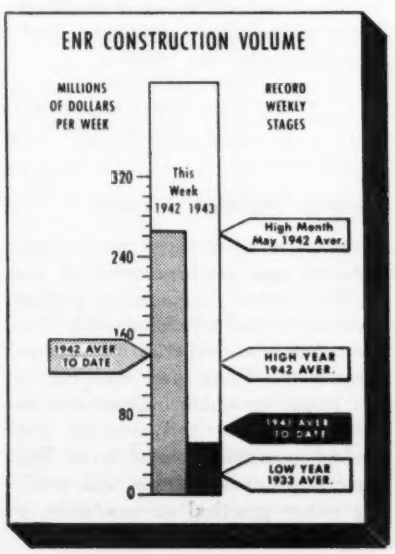
The toll rate, set on the basis of pre-rationing traffic, if proved sufficient to finance the bridge may also prove to be prohibitive. The present law provides that operating charges for the bridge, including interest and retirement of bonds, shall come from toll revenues at the rate of $375,000 a year. Under this law there is no alternative than to level tolls calculated to meet all costs however high a unit charge may be.

Results of the survey will be tabulated and made available to the General Assembly to be reviewed for the purpose of determining whether new legislation will be required. One solution stressed by the Assembly is repeal of the present law and the establishment of a moderate and reasonable rate of toll, making an outright appropriation to the amount of difference between the toll revenues and the required rate of retirement of bonds, together with maintenance and bridge costs.

CONTRACTS AND CAPITAL

CIVIL ENGINEERING construction volume for the short week due to the Washington's Birthday holiday totals $54,646,000. This is 80 per cent below the total for the corresponding 1942 week, and compares with $98,861,000 reported for a week ago. Private work tops a year ago by 17 percent, but public construction is 84 percent lower as both state and municipal volume and federal work declined.

The current week's construction brings 1943 volume to $533,068,000, an average of $66,634,000 for each of the eight weeks of the year. On the weekly average basis, this year's total is 53 percent below that for the nine-week period last year. Private construction, $52,059,000, is 51 percent lower than in 1942, and public work, $481,009,000, is down 53 percent, on the adjusted basis.



In the classified construction groups, gains over the preceding week are in waterworks, bridges, and industrial buildings. Industrial building is the only class of work to record an increase over the corresponding 1942 week.

New capital for construction purposes for the week totals $872,000, and is made up entirely of state and municipal bond sales. New financing for the eight-week 1943 period, $15,539,000, compares with $1,372,463,000 reported for the nine weeks of 1942.

CONTRACTS

(Thousands of dollars)

	Week Ending Feb. 26 1942	Feb. 18 1943	Feb. 25 1943
Federal	$248,143	$91,801	$38,899
State & Municipal	5,475	1,674	544
Total public	$253,618	$93,475	$39,443
Total private	13,004	5,386	15,203
TOTAL	$266,622	$98,861	$54,646
Cumulative 1943 (8 weeks)			$533,068
1942 (9 weeks)			$1,263,603

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1942 9 weeks	1943 8 weeks
NON-FEDERAL	$130,508	$15,539
Corp. Securities	28,832	.....
State & Mun.	87,847	14,039
R.F.C. loans	13,829	1,500
FEDERAL	$1,241,955	.....
TOTAL CAPITAL	$1,372,463	$15,539

ENR INDEX NUMBERS

Index Base = 100

		1913	1926
Construction Cost	Feb. '43	283.48	136.27
Building Cost	Feb. '43	226.90	122.66
Volume	Jan. '43	172	76

FHA MORTGAGES

	Week Ending Feb. 21 1942	Feb. 13 1943	Feb. 20 1943
Selected for Appraisal			
Title II	$16*631	$4,236	$4,305*
Title VI	$21,511	$17,210	$11,713*

* Subject to revision.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Hays Process Evaluation

Sir: The recent article on contact aeration (*ENR* Jan. 28, 1943, p. 138) was the first presentation of the factors and principles of design of the much discussed Hays process that we have seen in print. Now that the viewpoint of the designing engineer has been presented, it is hoped that another article may follow, reciting the experiences of some of the plant operators.

Some operating results from Army camps have already been presented by Kessler and Norgaard in the November, 1942, issue of *Sewage Works Journal*. Their paper summarizes the experience of operating 27 Hays plants at camps in the south and southwest areas.

It is interesting to note that the high removals of B.O.D. and suspended solids claimed for the process by Griffith could be obtained. In achieving these removals, the prime consideration is the cost of power. The activated sludge process will accomplish the same removals using an average of one cu.ft. (free-air basis) of air at 7.5 psi. per gallon of sewage. Griffith points out that the Hays process requires only 4 psi. pressure, equivalent volumes of which on a free-air basis may be obtained with 33 per cent less power.

Analyzing Kessler's data, it will be noted that considerably more air than the 0.9 cu. ft. per gal. specified by Griffith was necessary. It was not until 3.5 cu. ft. of air was supplied that removals of B.O.D. approximated 90 per cent. One plant with a very weak sewage did accomplish a B.O.D. removal of 89 percent, using only 0.67 cu. ft. of air per gallon. Activated sludge plants have been similarly successful with weak sewage, the results at the Chicago plants being the outstanding ones.

The basis for comparison of power consumption would be the power demands of the blowers required for delivery of the required air. It will be found that 3.5 cu. ft. per gallon at 4 psi. would require 55 hp. for a 1-mgd. plant, while an activated sludge plant operating on similar sewage might require 1 cu.ft. per gallon at 7.5 psi., or 25 hp. for a 1-mgd. plant. It must be remembered that many high-rate filter plants are accomplishing removals that are somewhat lower, but with power requirements for recirculation of only 10 to 15 hp. for a 1-mgd. plant.

A complete evaluation of power requirements must await more results from the many other plants in operation. It would appear that a more definite correlation is necessary between air requirements, surface area of plates and optimum B.O.D. loading. These in turn can be based only on complete data covering all strengths and types of sewage.

Many of the advantages claimed by Griffith have been verified by the plant operators. It is evident from the article by Kessler and Norgaard that many difficulties, some of which were pointed out by Griffith, still confront the operator. Only when a meeting of minds between the designer and operator is achieved on the basis of much experience, trials and changes, can the ultimate in plant design be achieved.

Meanwhile, the sanitary engineering profession awaits a sound analysis from the economical, biochemical, mechanical and operational viewpoints before accepting or rejecting the process for the important postwar period that lies ahead.

ROLF ELIASSEN
Major, Corps of Engineers
North Atlantic Division
New York, N. Y.

College Welding Awards

Sir: The response from the colleges to our announcement of the $6,750 Annual Engineering Undergraduate Award and Scholarship Program has been cooperative and commendatory. There are, however, a few responses which indicate that in certain instances it is assumed that student contestants must have had some previous connection with welding either practical or academic in their course of study. This misunderstanding is evident by such phrases as "although welding does not come under this department", and "your announcement is being referred to the welding department of our shops".

The program is open to all students of engineering in *all* departments and the emphasis of the program is "Design for Arc Welding" and not on the technique of welding. Many managers and engineers in industry are effecting economies of labor and material and improving designs without themselves being adept in the technique of welding. It is the aim of the Foundation in the present student program to prepare student engineers for this same activity in their active professional work to come in the future.

It would be unfortunate if students in some areas were deprived of the opportunity of participating in this program on the mistaken impression that a technical knowledge of arc welding is necessary. The necessary background can be acquired by any student in a very few hours of reading.

A. F. DAVIS
Secretary,
The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio

Patents and the Engineer

Sir: Proposals have been recently published for amending our patent laws, which if adopted, will surely discourage inventors and thus retard our national progress. All such proposals should be thoroughly examined by the engineering profession and the profession should take constructive action thereon.

From time to time Congressional committees have studied the law, and while minor changes have been made, they have found the law to be satisfactory. It has stood the test of time. It is generally conceded to be one of the great motivating forces that has made the United States a land of free enterprise and individual opportunity and progress. The inventor of a useful improvement performs a public service. Obviously the public must benefit by an invention or it will not buy it. The royalty paid to an inventor is his share of that profit for a few years. After that his invention is public property.

It may fairly be said that cumbersome and expensive court procedure, rather than the law have been re-

sponsible for miscarriages in adjudicating patents. Patent cases, like other cases which involve highly technical matters must be tried before courts which usually have little understanding of the technical matters involved. This writer believes that if the law required that patent cases be tried by commissions composed of, say three members—one lawyer or judge and two qualified engineers or technical experts—much time and expense would be saved and much better decisions would be had. The technical members of the commissions would understand the technical features, and could explain them to the legal member. He in turn would rule on all legal points involved and arbitrate between the two technical members if they differed. Thus the cause of justice and the public interest would be more efficiently served.

The engineering profession has been charged, and I think rightly, with too much preoccupation with its own affairs and too little interest in the general welfare and cultural pursuits. It could perform a notable public service by taking an active interest in legislative matters, such as this one, and in seeing to it that nothing is done that will hamper and discourage individual initiative.

WALTER H. WHEELER
Designing and Consulting Engineer, Minneapolis, Minn.

Drought Studies

Sir: With reference to my paper "*Further Cartographic Studies of Drought*" which you did me the favor of reviewing in your issue of March 26, 1942, p. 503, but which owing to war's delays, did not come to my attention until late summer, I venture to suggest that W. B. Langbein, the reviewer, has apparently overlooked the fact that being a war-time paper, being published in London, in January, 1941, it had to be as brief as possible; also being in continuation of an earlier paper, "*The Cartographic Study of Drought*," published in London, in October, 1934, it was intended merely to describe the method of developing further yardsticks, or standards, for determining the extent and intensity of drought, throughout a region, over a lengthy term of years; the former paper indicating the method of developing standards for measuring the month to month variation in the extent and intensity of drought, during any specific visitation of drought; consequently there was no intention of publishing ancillary data, showing deficiencies in stream flow, water supplies, stock returns and crop yields, which at present, in many extensive areas, are neither so detailed, widespread, or continuous, for any lengthy period, as to afford any true correlation with the deficiencies in the better distributed and lengthier continuous data on rainfall.

But that is not to say that there is no confirmatory data, since I have a considerable volume of such data, in the form of district stock and crop returns, residual mass curves of monthly stream flow and rainfall, reservoir condition diagrams, etc., with respect to specific, but very much smaller areas than that reviewed in the paper under discussion, which exhibits such high correlation with the drought data, as to justify me in thinking that if and when such large scale ancillary data is available, it will accord with the drought standards derived from my methods.

With regard to Mr. Langbein's question concerning use of mid-summer months to start the annual cumulations of precipitation, in the review of drought incidence over the 50 year period, 1886/1935, there was no need to consider any water year, in the systematic tabulation of the records, which were arranged under the month of commencement of each drought and were therefore arranged in calendar order.

Also, although the water year October-September applies aptly to water supply and streamflow questions in the U. S. and other countries in the Northern Hemisphere, in S. Africa and in the winter-rain area of S. W. Western Australia, the water year runs July-June, nor does it accord with S. E. Queensland, a summer-rain area, with the wettest months, October, November, December and January arranged in decreasing order, and the hottest months January, February, December and March, in the same order.

For record purposes, although not mentioned in the paper under review, all my data was classified in calendar order and subclassified as: 1. Major droughts, lasting 12 months, or more. 2. Minor droughts, lasting 3 to 11 months, but excluding those grouped under heading 3. 3. Dry-season droughts, lasting 3 to 6 months, which originated and terminated during the normal dry season, usually lasting from May to October.

In some areas, particularly humid areas, drought effects may be manifested for deficiencies much less than 50 percent of the long term mean, but the method of analysing the data need not be modified by the change to a lesser drought limit; much however depends on the duration of the period over which the mean is determined: this period varying considerably from place to place, and ranging in my extensive series of lengthy records, from 25 to 167 years; the period being the longest intercept on the x axis of the residual mass curve of monthly or annual rainfall, at the specific station.

For areas where adequate continuous records of rainfall, temperature, relative humidity, wind velocity and direction are available at a sufficient number of stations, greatly improved drought charts may be produced; in fact, such is the ideal, but unfortunately such areas are at present by no means common.

W. R. BALDWIN-WISEMAN
University of Western Australia, Nedlands, Western Australia

"Big Inch" Pipeline Data

Sir: Your editorial, "Lifeline for Victory" (*ENR*, Dec. 31, 1942, p. 900), dealing with the "Big Inch" pipeline, inspires the following questions:

1. How fast does the oil move?
2. How many gallons of crude oil will be delivered in 24 hours?
3. What is the normal daily requirement for crude oil on the eastern seaboard?

E. C. SHERWOOD
New York, N. Y.

[Movement of crude oil through the pipeline is expected to average about 6 ft. per sec., or slightly more than 4 mi. per hour. Capacity of the "Big Inch" line is 12,600,000 gal. a day. In normal times, oil requirements on the eastern seaboard total 63,000,000 gal. daily; present overall consumption data are not available. Incidentally, it will require about 75,600,000 gal. of oil just to fill the line. —*Editors*]

EDITORIALS

VOLUME 130 NUMBER 8

February 25, 1943

Materials Problem Changing

As THE WAR FACILITIES program is trimmed to the new pattern laid down for 1943, there are certain to be shifts in the relative scarcities of materials. The first evidence of this is found in the War Production Board's relaxation of restrictions in the use of steel bars for reinforced-concrete construction. Reinforced concrete now can be used for structures that will aid the war effort or for structures that will serve a useful purpose after the war. It is conceivable that supplies of high-stress-grade timber, structural steel and cast-iron pipe may also become less tight later in the year. That is an encouraging prospect. But regardless of such a possibility, the order of the conservation division of the WPB relaxing restrictions on reinforcing bars in itself is a most encouraging sign. It is a demonstration that machinery set up to conserve critical materials can and will be put into reverse when the supply of those materials becomes less acute.

Another Job Ahead

NOT THE LEAST OF THE JOBS to which engineers and constructors will be called upon to devote themselves in the next few years will be hospital building. Already a considerable amount of such construction is under way, sponsored by the military services and by the Federal Works Agency. Military needs are dictated in part by the need for hospital facilities at camps already established and to make provision for the care of war casualties returned to this country. The Federal Works Agency is concerned with the task of supplying additional hospital facilities for civilians in communities that are now taxed with war industry activities. Most of the present building, however, is of an emergency nature and for war needs alone. There are many reasons to anticipate a vast program of permanent hospital improvements: First, there will be the obligation to provide facilities for war veterans; second, there will be required enlarged civilian facilities resulting from a widening of social security and medical benefit programs; and third, existing facilities, many of which are outmoded and inadequate, must be modernized and enlarged. In most instances these will be large operations in which a variety of architectural and engineering skills will be needed. They may thus provide a field in which the combinations of architectural and engineering organizations that proved successful on war jobs may be able to participate in postwar development.

Expansion Effects Simplified

AN INNOVATION in handling expansion forces in a large bridge is to be found in the new Mississippi River crossing at Dubuque, Iowa (see page 282). The main part of the bridge consists of a three-span truss unit with the central span a tied arch, all carried on fairly high piers to give adequate clearance in the navigable channel. The outer ends of the truss unit rest on rocker columns, and at the intermediate piers, the supports are conventional roller shoes. At one of the intermediate piers the horizontal wind and traction load is transmitted to the pier at its center by a large steel pin extending from the pier up through a hole in the floor-beam assembly. By this arrangement, torque is eliminated in the piers and a considerable saving in steel reinforcing is made possible. In connection with the current trend toward greater use of long-span continuous structures, an arrangement of this kind appears to hold possibilities for considerable economy in pier design.

Future for Vacuum Flotation

VACUUM FLOTATION, a physical treatment process to aid in the removal of grease and difficult-to-settle solids from sewage and industrial wastes, holds promise for wide application in the postwar period. While the process offers a new approach to the solution of grease and scum removal problems, the principles of its operation have had successful demonstration in paper-waste recovery practice for some time. As described elsewhere in this issue, the vacuum flotation process has been under development for several years and, in fact, had reached the stage when it was adapted for immediate use in synthetic rubber manufacturing. Meantime, some installations in municipal sewage and industrial waste treatment plants have been made, the results from which are being checked against pilot plant and laboratory work. These results hold firm promise that in the challenging field of industrial waste treatment practice, vacuum flotation should find many useful applications.

Penny-Wise and Pound-Foolish

CONGRESSIONAL MOVES to bar appropriations for the National Resources Planning Board in an effort to reduce federal expenditures during wartime have been characterized by President Roosevelt as "spendthrift." There are many who will share this view with the President.

The board now is engaged on one of its most important tasks—postwar planning of public works—and already it has stimulated local and state governments in the preparation of plans and specifications for work that can be undertaken as soon as the war ends. Having been a witness to the confusion that existed in the early days of PWA and other work-relief activities, the board has preached, and is now putting into practice, the philosophy of programming public works in advance of need.

Unfortunately, the board talked so much about great social problems as to create an impression among Congressmen and others that its chief objective was the advancement of social changes that many believe to be visionary and impractical. This impression has obscured the real value of the factual information to be found in many of its studies.

One of these studies, "Our Cities—Their Role in the National Economy," is worthy of special mention. This provided one of the most complete analysis ever made of urban trends, needs, handicaps and recommendations to retain existing community values. Although this report was made prior to the war, it represents today one of our most valued documents to aid in planning the postwar rehabilitation of our cities. Other reports, likewise, contain much of the necessary, basic information for work to be undertaken in the future.

Because of the continuing value of its past activities, the undeniable importance of its present contributions, and the potential promotion of worthwhile future undertakings, Congress should not now indulge in the penny-wise, pound-foolish action of curtailing the work of the National Resources Planning Board. The only justification for such action would be a proposal by Congress to establish a comparable agency that would be more directly responsible to Congress for its acts than is the present board.

The nation needs an agency that can do some long-range thinking with respect to postwar developments and can coordinate not only the planning of federal, state and local agencies with respect to public-works construction in the postwar period but also can integrate the thinking of both private and public agencies with respect to the major economic problems that will face us after the war is won.

No Check on the War Effort

VIEWS EXPRESSED IN CONGRESS with respect to abolishment of the National Resources Planning Board are but a reflection of a view that frequently finds expression in the statement "Why spend time now in postwar planning, let's win the war first." All will agree that our major objective now should be to win the war, but winning the war and planning for peace are not mutually exclusive.

Everyone cannot have a direct share in winning the war by serving in the military forces or by working in a war plant; some must carry on essential civilian operations, and these people can and should be giving a lot of thought to the postwar period. Unless we do that thinking we will not be giving our men in the armed forces the full support they deserve, for in addition to supplying their immediate physical needs for food, clothing, shelter and munitions of war, we must give them the moral support that will come from knowledge that we are preparing to provide them with peace-time jobs when the war is over. We can do that only by far-sighted planning for a sound postwar economy.

The advanced planning for postwar highway work now being done by state highway departments serves as a good example of what may be accomplished without slowing the war effort.

There are many engineers and architects in private practice who can hardly be expected to be absorbed in the immediate war effort for one reason or another. These men could render a useful service to postwar rehabilitation of the nation's economy if provision were made for their employment by local or regional agencies that should be putting their advance planning into tangible form. Expenditures made for plans and specifications today will speed the rate at which men can be released from the armed forces or from war industries with assurance that peace-time jobs are ready for them as they are released.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN, *Editor* *Copyright 1942, by McGraw-Hill Publishing Company, Inc.*

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EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK, N. Y.

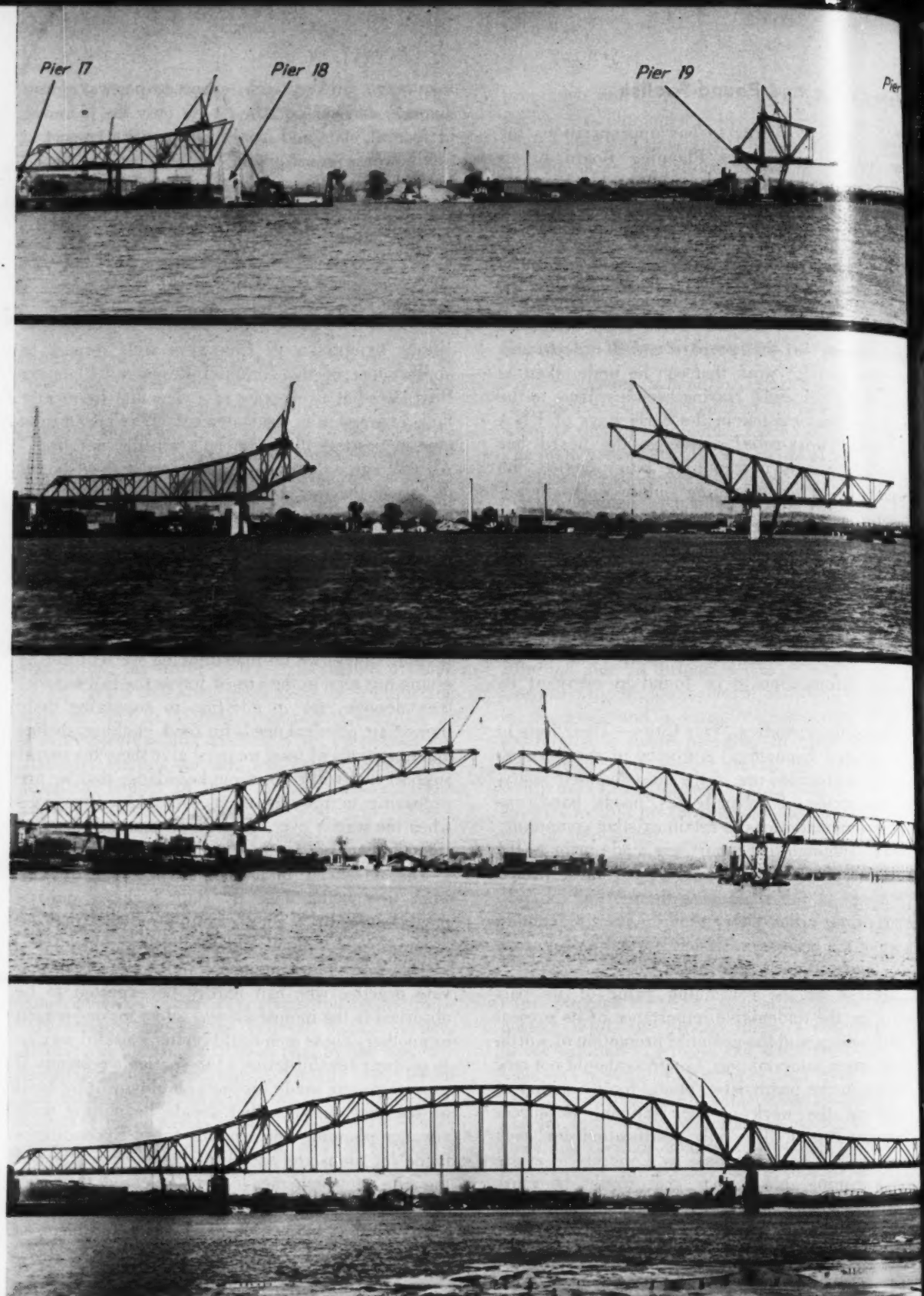


Fig. 1. Construction of the west half of the trusses eastward from Pier 17 required two falsework bents in the end span. One of the bents had been removed when the top picture was taken. By cantilevering both ways from Pier 19 no falsework bents were required in erecting the east half of the trusses. After the connecting members had been erected to complete trusses, top chord travelers erected the hangers, ties, and floorbeams as they backed away.

Fig. 2. Flanked by girder approaches, main crossing is a 3-span truss with central span a tied arch. View is from Iowa side.

A Three-Span Continuous Truss Bridge With the Middle Span a Tied Arch

***Contents in Brief**—Central portion of a new Mississippi River bridge at Dubuque is a 3-span continuous truss with an 845-ft. middle span built as a cantilever and made a tied arch by addition of bottom chord tie members. The structure also is uncommon, possibly unique, in the way expansion is accommodated. At the end piers 8-ft. long rocker columns are employed, at both ends of the arch the usual expansion shoes riding on nested rollers are provided under each truss, and at the east end of the arch a large pin embedded at the center of the pier extends upward into the floorbeam to carry the longitudinal wind load without producing torque in the pier.*

To REPLACE an old crossing built in 1887, a continuous truss structure of a type uncommon to American bridge building is now under construction across the Mississippi River at Dubuque, Iowa. A 3-span continuous truss unit with 347-ft. side spans and an 845-ft. central arch is employed for the main river crossing. The middle span was built as a cantilever, and when the trusses had been joined at the middle of the arch, the hangers, floor system and bottom chord ties were added to make what is believed to be the second continuous-truss, tied arch bridge in the United States; the first American crossing of this general type is the Meramec River Bridge south of St. Louis, which was described in *ENR*, June 5, 1941, p. 896. In addition to the design, the Dubuque bridge is of interest because of the erection methods followed.

One of the first designs considered for the main river crossing consisted of two central 600-ft. tied arch spans, but objection arose as to the location of the central pier and a longer span at the middle of the river was ordered by the Corps of Engineers. Other designs studied included a suspension bridge and a straight cantilever. However, the design now nearing completion proved most desirable on account of reduced steel requirements, other economies in construction, and general appearance.

The steel savings possible with the crossing soon to be completed result from two conditions: (1) inherent savings in the design followed and (2) few members had to be strengthened for erection purposes. This latter saving follows from the fact that the trusses during erection are considerably lighter than would be possible with a conventional cantilever or a continuous truss structure, since with the design used about 50 percent of the steel for the central span can be erected after the trusses have been completed. In addition, the long central span permits the west channel pier to be so located as to cause no interference to river traffic, which is especially important because of the Dubuque docks at the west end. Also, the limited number of steel members required at roadway level in the central span permits motorists and pedestrians to obtain an almost unobstructed view of the Mississippi River.

Bridge spans many railroad tracks

Overall length of the all-riveted structure being built, which will provide a 24-ft. roadway, a 5-ft. sidewalk, and a 2-ft. safety walk, is 5,760 ft. At the west or Iowa end, 17 continuous girder spans, varying in length from 44 to 187 ft., are used, and at the east end 23 similar girders of 85 to 184 ft. are employed. The bridge crosses over 29 tracks of four different railroads with many of the piers built on a skew. Clearance above high water at the middle of the central span is 50 ft. The new crossing will carry Highway U. S. 20 across the river on a new alignment that will require a 3-degree curve in the west approach and a 6-degree curve at the east end.

The design was for an H-20 live loading, conforming to the 1935 Specifications of the American Association of State Highway Officials, with supplemental provisions suitable to the unusual length of the main span. Center to center of the trusses for the 3-span unit is 35 ft. and the length of all panels is 38 ft. 5 in. The trusses, as measured from the center lines of the chords, are 70 ft. deep over the piers at the end of the central span and they reduce to 24 ft. at the center of the arch. The roadway at the arch center is about 102 ft. below the bottom chord of the trusses.

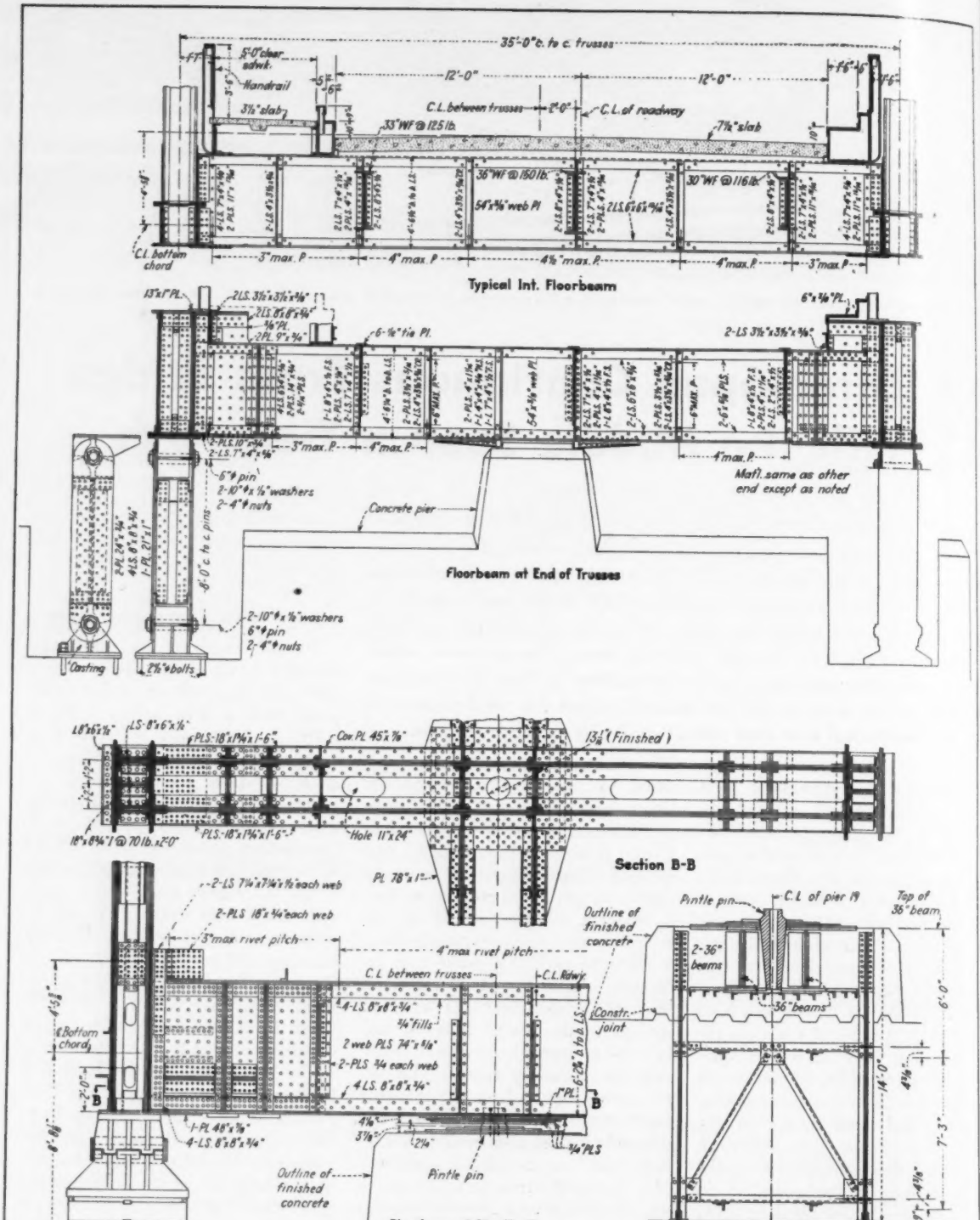


Fig. 3. Most floorbeams for truss spans are of top design, which also shows roadway details. Ends of trusses are supported by 8-ft. long rocker columns; since columns were not designed to carry transverse wind loads, this load is transferred to pier through floorbeam by strengthening this member at the ends and adding brackets each side of pier top. At each end of middle span floorbeams have double webs. That at Pier 19 accommodates pintle pin that carries the longitudinal wind and traction loads for entire 3-span unit. A structural framework encased in concrete near top of pier is provided to support pin, as shown by lower right detail.

Top and bottom chords are of very similar construction and consist of two I-beams varying in depth from 24 to 36 in., cover plates top and bottom, and side plates as required. The aggregate cross sectional area of a single chord varies from 64.13 to 248.72 sq. in. The diagonals are mostly two channels and a cover plate on each side; these members vary in gross area from 28.8 to 85.9 sq. in. The typical hanger is a 19-in. wide plate and four bulb angles, giving a cross section of from 20.34 to 27.06 sq. in. The bottom chord ties in the central span are each made up of two 24-in., 120-lb. I-beams, a 32-in. cover plate top and bottom, and 20-in. side plates, varying in thickness from $\frac{3}{4}$ to $\frac{7}{8}$ in.

A typical interior floorbeam consists of a 54x$\frac{3}{8}$-in. web plate and two 6x6x$1\frac{1}{16}$-in. angles. However, over the piers at the end of the arch 74-in. deep box girders with two 74x$\frac{5}{8}$-in. web plates, two 45-in. cover plates, and four 8x8x$\frac{3}{4}$-in. angles top and bottom are used. Three lines of stringers are employed. That at the center is a 36-in., 150-lb., wide flange beam, that on the sidewalk side a 33-in. 125-lb. member, and the third a 30-in., 116 lb. beam. Spacing of stringers and a cross-section through the roadway are shown by Fig. 3.

Rocker columns at the ends

At both of the end piers of the 3-span central unit rocker columns about 8 ft. high are used as expansion shoes. This height of rocker was necessary to conform to the space required for the vertical jacking operations during erection. Expansion shoes also are provided at both ends of the arch span. Each of these four shoes is carried by a nest of five 12-in. dia. carbon steel rollers 5 ft. 3 in. long.

At the east end of the arch, at Pier 19, a large pintle pin is embedded at the center of the pier. It is supported by an encased structural frame and extends up into the floorbeam. This pin, which is of forged steel with a 5-in. dia. hollow center, is 4 ft. $4\frac{1}{2}$ in. in overall length and varies in diameter from 12 in. at the top to 8 in. at the bottom. It extends 9 in. into the double floorbeam, where the thickness of the steel is 5 in. The pin will carry all longitudinal wind and traction loads for the entire 1,540 lin. ft. of truss. Its use eliminates any torque in the pier due to transverse wind loads; fixing both shoes of such a span would have introduced a heavy torque in the pier from the lateral deflection of the lower lateral system. Thus, the unique arrangement followed has great advantage for the long spans involved.

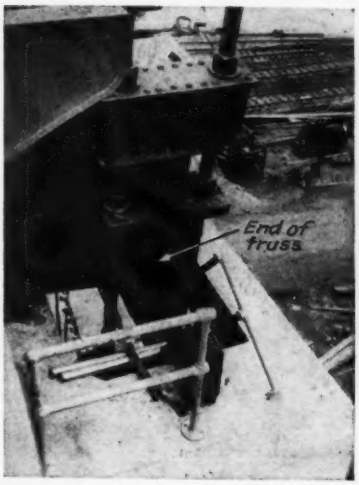


Fig. 4. During erection the end of each truss was tied down by two 4-in. dia. rods. A hydraulic jack in each tie permitted changing the elevation of the ends as desired. Truss was lowered by turning down bottom burrs and extending jack, and raised by turning up top burrs as jack was extended.

Fig. 5. Below each truss at Piers 18 and 19 shoes of the type above were used. When this picture was taken at Pier 19 that shoe had been frozen by welding to the top of the shoe Plate A, which is bolted to the bearing plate. Later the shoe was made free by cutting away Plate A.

The step-by-step operations followed in erecting the steel for the 3-span continuous truss are shown by Fig. 1. Work started on the landward pier at the Iowa end or at Pier 17 and by means of a falsework bent the first two panels were erected by a 60-ton capacity locomotive crane operating on the ground and a 40-ton capacity traveler operating on the adjoining approach span built previously. To start erection the floorbeam at Pier 17 was set 9 in. east of its theoretical position.

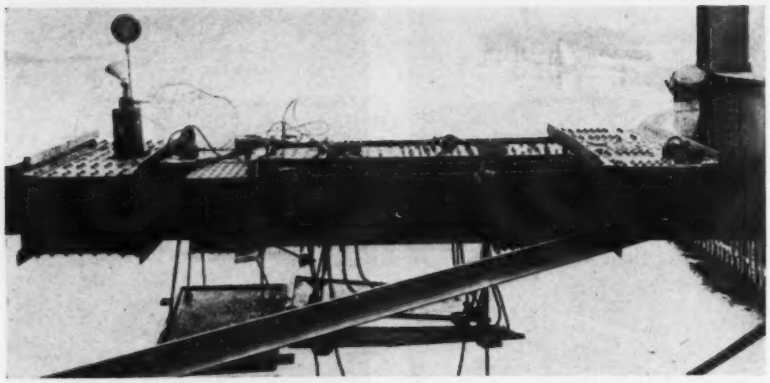
Instead of adding the 8-ft. long rockers required at the end of each truss a temporary tiedown of the type shown by Fig. 4 was installed. Each tie consisted of two 4-in. dia. rods tieing the truss to the permanent shoes, and in each tie a hydraulic jack of 250-tons capacity was installed. By means of two sets of nuts on the rods with the jack in between, it was possible to raise and lower the end of the truss as later required. In addition tiebacks extending from the pier to the second panel point were added. Each of these ties consisted of two parts of 1-in. dia. wire cable.

When the two panels had been completed, the 40-ton traveler erected on the deck of those panels a traveler of 16-ton capacity. The latter unit and the locomotive crane at ground level continued the erection work to Panel Point 4, which was supported on a falsework bent resting on hydraulic jacks. The 16-ton traveler next erected a 35-ton capacity traveler on the top chord at Panel Point 5. From here the 35-ton traveler completed erection of the steel, which was now delivered by barge, to Pier 18 by cantilevering. When the expansion rollers were erected on this pier the shoes were frozen with the trusses $10\frac{9}{16}$ in. east of their normal position.

Next the top traveler continued eastward to erect alone the remaining steel for the west half of the arch. During all of these operations Point L_0 of the truss (at Pier 17) had been held about $3\frac{1}{2}$ ft. below its final elevation by the tiedowns previously mentioned.

Cantilevered erection over Pier 19

The east end of the main span was erected by balanced cantilevering over Pier 19. Steel for this work naturally had to be delivered by barge. On the east side of this pier an inclined falsework bent extending from the base of the pier to the first panel point in the end span was required.



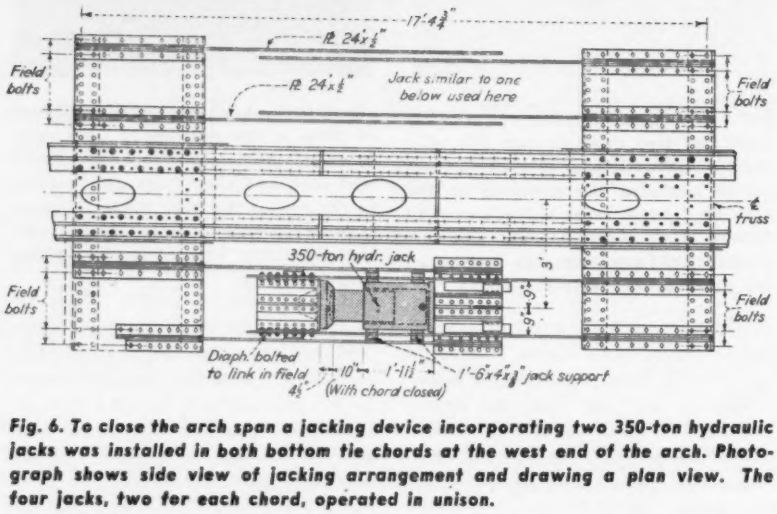


Fig. 6. To close the arch span a jacking device incorporating two 350-ton hydraulic jacks was installed in both bottom tie chords at the west end of the arch. Photograph shows side view of jacking arrangement and drawing a plan view. The four jacks, two for each chord, operated in unison.

This falsework was built of two sections of the longitudinal floor ties later to be used to make the central span a tied arch. Erection westward from Pier 19 in the main span was by a 35-ton capacity traveler working on the top chord of the trusses. In the end span a 30-ton capacity guy derrick advanced eastward on a movable platform on the floor system. At the start of the work Pier 19 plates were welded to the expansion rollers to make this joint fixed or frozen, as shown by Fig. 5.

The cantilevered construction over Pier 19 was maintained so evenly that maximum stress in each of the individual struts, which were each designed for 480 kips in compression and 510 kips in tension, was but 130 kips per strut. When erection in the east span had progressed to Pier 20, two 4-in. dia. tiedowns similar to those at Pier 17 were installed. When these rods were added the east end of the bridge was about 2 ft. below final elevation. The tiedowns were adjusted until Point L_{20} (east end of trusses) was $3\frac{1}{2}$ ft. below final elevation, as at the west end of the structure.

With the tiedowns in place, the remaining two central panels of the east half of the arch were erected, and the closing sections raised into place. At this time the opening at the bottom chord was $6\frac{7}{8}$ in. and at the top chord $7\frac{1}{4}$ in. The calculated deflection of the cantilever arms was about 2.4 ft.

Shoes at Pier 18 cut loose

To close the bottom chord the fixed shoes at Pier 18 were cut loose to permit the western half of the trusses to move eastward $6\frac{7}{8}$ in. or until the bottom chord sections were in bearing. Movement of the trusses was controlled by slacking off the tiebacks extending from Pier 17 to the second panel point of the west end span. This movement, which was very slow, was further aided by a 50-ton journal jack, shoving on the west end of each truss; the load on each jack was about 25 tons.

When the closing section in the bottom chord had been pinned and bolted, the tiedowns at Piers 17 and 20 were slacked off in simultaneous 3-in. intervals until the steel in the top chord came into bearing. At this time, which called for pinning and bolting the top chord sections in place, the tiedowns still held the ends of the bridge 3.256 ft. below final elevation. From the time the shoes at Pier 18 were cut until the closing was complete less than 4 hours expired.

As soon as the closing sections were in place, the travelers backed down the arch and erected the hangers, ties, floorbeams, and bottom laterals of the roadway system. However, before this work was started, the tiedowns at the ends of the bridge were slacked off to permit the ends of the bridge to rise to 1 ft. below final elevation.

Completing the tied arch

The design contemplated shortening the arch span by lowering the ends of the trusses at Piers 17 and 20 sufficiently to connect the bottom chord ties in the unstressed condition. The contractor, however, elected to make the final bottom chord splicing connection by pulling the bottom chords together by direct jacking on them (Fig. 6). At the winter temperatures prevailing, the open space between the last splice connection of the bottom chords was about 10 in. Temporary diaphragms were bolted across each bottom chord at the west end of the arch or between Panel Points T_{12} and T_{13}. Link members extended from each diaphragm to jacking beams arranged so that standard hydraulic lifting jacks could be used. Two 350-ton jacks were employed at each bottom chord and the four jacks were operated in unison.

The arch span was thus shortened and the parts of this last splice of each bottom chord drawn together for riveting. After the bottom chord tie closure was made, the ends of the truss span, at Piers 17 and 20, were adjusted to correct elevation, and the rocker columns shoes were installed. Next, the 16-ton floor traveler working eastward from Pier 18, proceeded with the erection of the remainder of the floor system, including stringers, cross-beams, curbs and handrails.

The bridge is being built by the City of Dubuque Bridge Commission.

but the highway departments of Iowa and Illinois are participating with public road funds in partial payment of the structure. Total cost is estimated at $3,500,000 and the crossing is to be opened early next summer.

Howard, Needles, Tammen & Bergendoff, Kansas City, with Ivan P. Hanson, resident engineer, are the consulting engineers. Fred J. Robers Construction Co., Burlington, Wisc., and La Cross Dredging Corp., Minneapolis, Minn., for whom P. C. Peterson is superintendent, are the foundation contractors. Bethlehem Steel Co. with W. W. Oskin, resident engineer, Wm. Williams, assistant resident engineer, and Joe Campbell, superintendent, is fabricating and erecting the steel.

Beams of Glued 1-in. Boards Carry Railroad Line to War Project

A PILE TRESTLE with caps and stringers of 1-in. boards laid flat and glued together is carrying locomotives and cars on a war project access line built by the Corps of Engineers in central Florida. Cap timbers are 12 in. wide by 14 in. deep and stringers are 9x20 in., 30-ft. long, spanning 15-ft. c. to c. of bents. Three stringers are used under each rail with 2 in. open space between.

Beams were designed for 1,400 psi. and tested to 2,000 psi.—the capacity of the testing machine—without sign of failure. They were made up of random length pieces of the full width of the beam and, for the sizes required, were made available more quickly than full size timbers could be secured.

Members were made up in a commercial shop where presses were installed at 2 ft. centers to apply pressure while the glue sets. A machine applies 1½ to 2 oz. of powdered glue to each square foot of joint surface and the boards are then placed on edge in the clamp like presses. Scarfed joints are used at all splices of the boards and are coated with glue. The glue is a powdered urea formaldehyde with catalyst included and is applied and worked at a temperature of 70 to 80 deg. F. No nails or other fastenings are used.

Glue requires 6-hr. to set

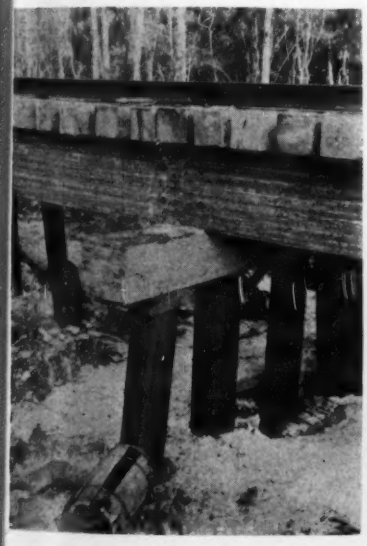
When the requisite number of pieces of board to make up the beam are in the presses they are pulled up to produce a uniform pressure, which is maintained for 6 hr. while the glue sets. The beam is then ready for shipment and immediate use.

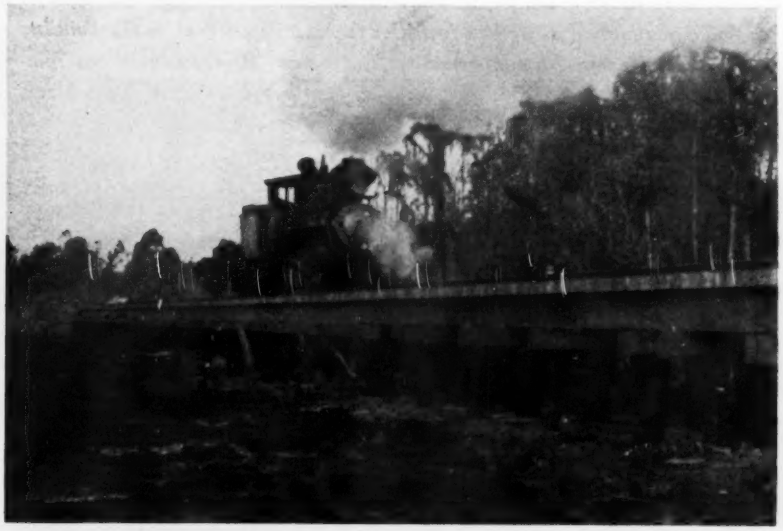
For the bridge shown the built-up timber cap is set on a 5-pile bent. Piles are 36 ft. long with 12-in. butt; the center pile is vertical, the next ones at 2 ft. 3 in. centers on a 1:12 batter and the outside piles are 2 ft. 3 in. further out driven on a 2:12 batter. The 12x14-in. cap timbers are drift bolted to each pile.

The 30-ft. long stringers are butted over the caps with alternate pieces ending on every other one of the 15 ft. c. to c. bents. Stringers are bolted to the caps and the three stringers under each rail are bolted through horizontally with a 2 in. thick washer for a spacer. Ends of the stringers are cut to form an inverted narrow "V" to compensate for end movement due to deflection under load.

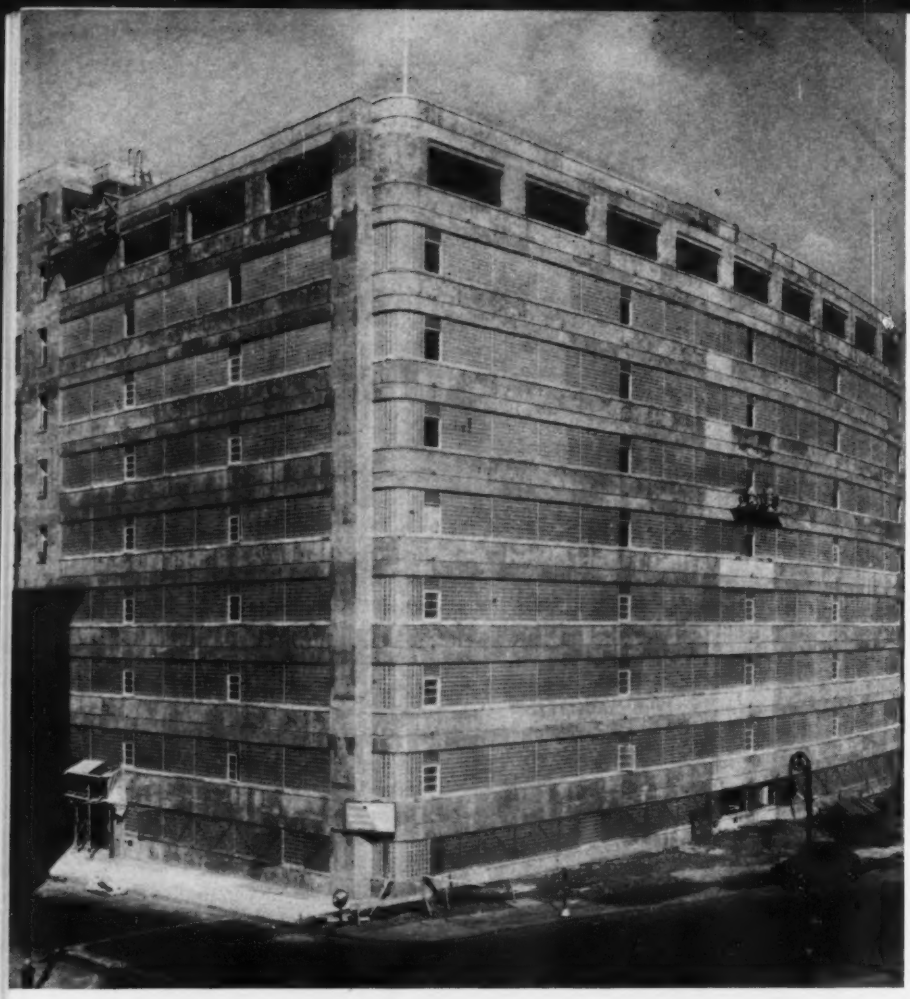
The rail is supported on untreated timber ties at 16-in. c. to c. Each third tie is bolted to a stringer and to a guard-rail placed at the outer end of the ties. Previously used 90-lb. rail is laid over the structure.

Insufficient equipment was available for handling the heavy timbers. Consequently, most of the stringers were moved out over completed sections of the structure and set in place manually. Ties and rail were handled in the same manner rather than wait for machines. Despite lack of equipment and a week's delay for material, construction of the 574-ft. long bridge was completed in 5 weeks.





Caps and stringers of this bridge are 1-in. boards glued together. Stringers are 30 ft. long and are spliced over alternate bents of piles, spaced 15 ft. c. to c. A guard-timber spaces and holds the ends of the ties. The structure will support the largest locomotives used on Florida railroads



Continuous bands of glass block provided good daylighting and add to attractiveness of this war production building. Louvres are for discharge of relief air from air-conditioning system.

War Plant With Glass Walls

***Contents in Brief**—A plant to manufacture special war materials required maximum daylighting as well as facilities to keep 85 percent of the building at constant temperature and humidity. The 9-story structure built has reinforced-concrete frame and floors, walls of continuous bands of glass block, fluorescent lighting, and an unusually flexible air-conditioning system.*

TWO MAJOR DESIGN requirements for a manufacturing building in an eastern city for war use were a maximum amount of daylighting and an air-conditioning system that could provide rigid, constant control of temperature and moisture content on all but the top floor. A total of 85 percent of the 260,000 sq.ft. of floor space had to be air-conditioned and the temperature maintained at 74 deg. F. dry bulb with a relative humidity of 44 percent. The air-conditioning system is designed in separate two-floor units so that stoppage of one unit would affect only a small part of the manufacturing process.

Site limitation dictated that the building be an L-shape with the front 204 x 175 ft. and the wing 116 ft. long. Space demands, coupled with the height of the adjoining structure, required that the building be nine stories high. Likewise, the need to avoid extensive use of steel favored a reinforced-concrete design over a steel-frame structure.

Spread footings adequate

Foundation soil is a mixture of sand and gravel capable of supporting a load of four tons per sq.ft. Thus, spread footings were considered adequate to carry the live load, of 200 lb. per sq.ft. on all floors. Round columns on a 22-ft. spacing each way are used and they vary in diameter from 34 in. for the basement to 16 in. for the upper floor. The story height is 15 ft. in the basement and 12 ft. 9 in. for the other floors of the building.

Floors are 8½-in. thick reinforced-concrete flat slabs and they are exposed in the basement and on the top floor. On the other floors the concrete slab is covered with 1⅛-in. diagonal maple flooring. The latter is laid over a 1½x6-in. yellow pine sheathing supported by 3x4-in. yellow pine sleepers on 16-in. c. to c. and embedded in a cinder concrete fill. The roof is a 7½-in. concrete slab covered by a 1-in. layer of insulation and 5-ply tar and gravel roof.

Continuous bands of glass block

To obtain the extensive daylighting desired for the building, yet have a well-insulated wall adapted to air-conditioning, a 6-ft. 7-in. high band of glass block is used in the exterior walls on all but the top floor. The remainder of the exterior wall is reinforced-concrete 9-in. thick that serves as the frame and spandrel beam of the building.

The bands of glass are a single course of 7¾ x 7¾ x 7⅝-in. blocks of a type known as directional light units. They have built-in prisms that deflect the incoming light rays upward to the ceiling which, in turn, reflects the light downward to the working areas. Thus, the daylighting is much better and deeper than if the light rays simply were permitted to strike the floor in front of the windows.

The glass-block walls are not only easy to wash and keep clean, but provide ample natural light. The glass-block construction is considered to have an insulation resistance equal to the 9-in. concrete spandrel beams. There was also the advantage that the glass block required few critical materials; glass block itself is plentiful and the only steel reinforcing required is two No. 10 wires in alternate horizontal joints. In addition to permitting rapid construc-

tion, the use of glass block walls eliminates infiltrated dust, and reduces condensation and heat losses due to radiation and transmission.

To obtain maximum distribution of daylight, interior partitions are kept to a minimum throughout the factory; where partitions are needed they are ordinarily of cinder block but some are of brick where fire walls are required. The daylighting will be aided still more by painting all the ceilings, walls and columns with white semi-gloss paint.

An exception to the glass-block walls just described is the arrangement on the top floor. This space will be used for testing the equipment manufactured, and the windows had to be of a type that could either be raised, lowered or folded back to leave clear openings. This requirement was met by the uncommon method of using fireproof wood-frame windows that raise upward to rest directly below the ceiling, such as certain types of garage doors. The window glass is a ¼-in. thick glazed material. Each window is 5 by 16 ft. and manually operated.

Fluorescent lighting

For artificial lighting all the floors are equipped with fluorescent units and in general four 120-w. fixtures, each a bank of three 40-w. unit, are used in each 22-ft. square bay. This arrangement is expected to result in an intensity of 45 foot-candles at floor level. On the sixth, seventh and eighth floors, or where hung ceilings are used, the lights are recessed in the ceiling.

To make possible a flexible air-conditioning system, each floor is divided into three zones and on the second, third, fourth, sixth and eighth floors is located a fan room housing two blowers varying in capacity from 30,000 to 57,000 cfm., and two large surface dehumidifiers. Equipment in each room supplies two floors, with the exception of that on the third and fourth floors, which is for those floors only. The rooms are all in the same general location and thus all the piping leading from floor to floor could be housed in the fan rooms. On each floor one sheet-metal supply duct suspended from the ceiling branches out to the three zones.

An air-conditioning system using separate fan rooms and individually controlled heating, cooling, dehumidifying and humidifying apparatus for each floor was chosen in place of a central-unit system because the individual units satisfied the need for flexibility. This limitation required that the system be designed to meet different control conditions for the individual floors and that the system permit normal operations to continue at night and on week ends on some floors while operations on the other floors were halted and the air-conditioning units in those areas shut down. In addition, a saving of floor space and distribution ducts was possible by having individual fan rooms.

Used air will be returned to the fan rooms by large grids in the walls of those rooms. Before recirculation of the air about 15 percent fresh air will be added. This supply will be obtained at each fan room from louvred openings at the back of the building. The fresh air will be delivered at 46 deg. F. and then warmed by steam heaters so that it leaves the supply ducts at 55 deg. F., or above.

Provision also has been made to add more than the 15 percent minimum of fresh air, either by manually operated controls or by automatically controlled dampers, when the outside

Because of a good foundation soil spread footings were permissible. The columns are on a 22-ft. spacing each way and in the basement they are 36-in. diameter.

For the floor slabs the forms were of plywood and for the columns adjustable metal shells, as illustrated below. Each of the forms are labeled for use in the same location on all floors.

With concrete delivered as transit mix and distributed by two-wheel buggies, it was possible to construct one floor every five days, including assembly and removal of the forms.

weather permits economy by the use of outside air in lieu of the return air. When increased quantities of fresh air are used, the 3x3-ft. relief air vents or louvres located on 50-ft. centers in the exterior walls on each floor will be used to exhaust the excess of used air.

Central cooling unit

Chilled water for the cooling coils of each fan room will be supplied from a central cooling unit in the basement. This unit will consist of two 460-ton compressors and a cooling medium of monofluortrichlormethane will be employed. Condensing water will be obtained from two drilled wells under the building. The wells are 135 ft. deep and they are expected to supply a total of 1,500 gpm. at temperatures between 55 and 70 deg. F. The discharge condensing water will be returned to the ground by two diffusion wells.

For heating the building during the winter steam will be supplied from a neighboring plant. Starting with a 5-in. dia. supply line carrying steam at a pressure of 125 psi., the steam distribution system is as follows: Steam at reduced pressure of 5 psi. will be delivered to the preheater stacks, reheater stacks and hot-water heaters for the dehumidifiers that are required in or near each fan room. Steam reduced to a pressure of 2 psi. will be delivered to the blower-type unit heaters for direct heating in the entrance lobby, freight loading area, and certain spaces on the ninth floor. Steam at 2 psi. will be delivered to the radiators in the stair halls, the entry ways, toilets and wash rooms, and to the radiators along the exterior walls below the bands of glass block; the latter radiators are to prevent cold spaces near the outside walls.

Because the manufacturing equipment to be housed may be shifted about, a flexible arrangement was necessary to provide power outlets where needed. The scheme finally chosen was to have a central power board and to provide direct connections by underfloor ducts to the machines that are to be definitely fixed. For the units that may be moved about power will be delivered by three to four outlets about 10 ft. above floor level at each interior column. Then in addition large power cabinets are provided on alternate columns at about the same level. These cabinets may be shifted from column to column if power needs are increased in one area and reduced in others.

Construction of the building was very rapid and in 4½ months after excavation for the basement started the building was ready for the first machinery to be installed. Two pours were used to each floor, and about every five days one story of height was added.

Sheet-metal forms for the columns and plywood forms for the floor slab and spandrel beams were employed. The general practice was to place the concrete for one-half of a floor while the forms were being erected for the rest of that floor and one-half of the floor above. The forms were marked so that they were always used in the same location on each floor and the general practice in moving the forms from one floor to the next was to dismantle the forms and carry the sections over to the edge of the building where they were lifted to the next level by hand winches. The forms were left in place a minimum of two days after the concrete was placed.

The concrete was delivered by truck-mounted mixers and dumped by gravity into a 20-cu.yd. hopper below street level and near the middle of the long side. It was then raised by a tower materials hoist and dumped into a hopper on the floor being constructed. Distribution to various parts of the building was by two-wheel buggies.

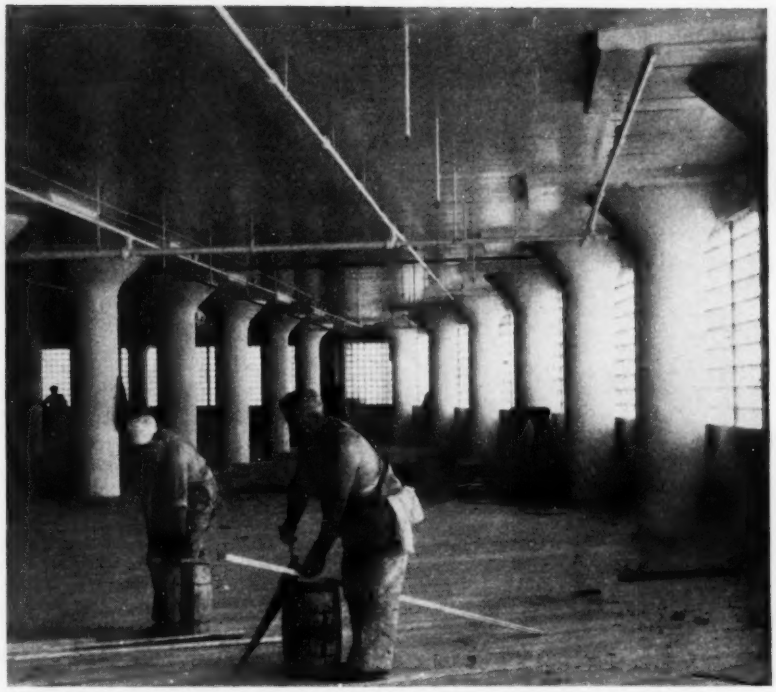
For the columns, a 3,500-lb. concrete was specified and to this concrete an admixture was added to increase the workability and imperviousness of the finished product. For the floors and spandrel beams a 3,500-lb. concrete was used.

Reinforcing steel was delivered by skip about 50 ft. from the materials tower. This skip, which was about 25 ft. wide, had a capacity of 5 tons and was operated by a gasoline-driven, 150-hp. engine. Materials were taken off at the top floor by an automatic skip. In all, 1,000 tons of steel and 16,000 cu.yd. of concrete were required.

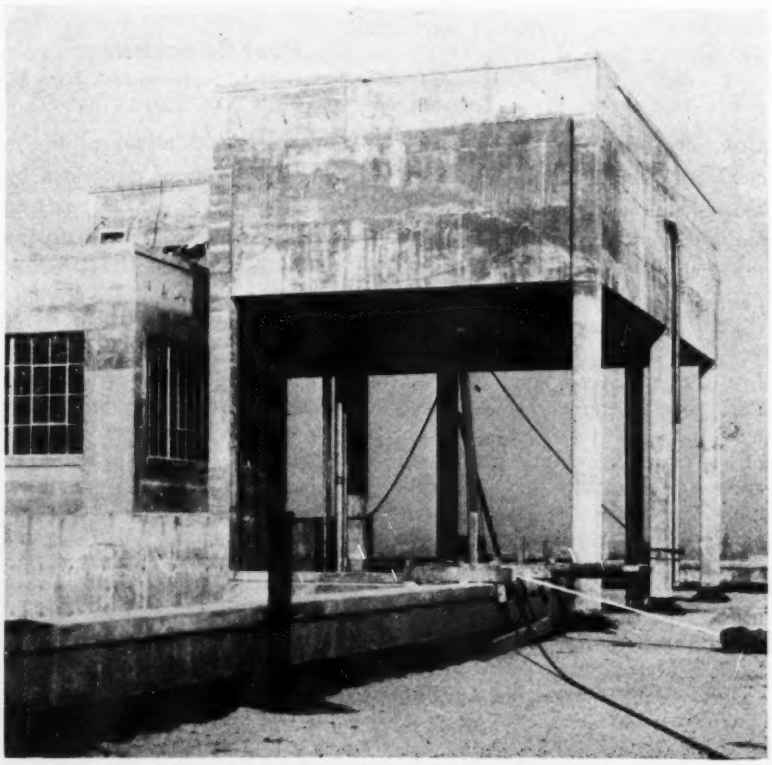
An unusual feature in constructing the exterior facade of the building was that the entire front was built on the arc of a circle having a radius of 759 ft. This was done to conform with the new building line created by a highway improvement. The variations in curvature along the front of the structure were obtained with great accuracy by constructing the various segments of the arc along fixed wales clamped into position tangentially with the circle, and by taking up the slight variations in curvature by varying the thickness of the form studs against those members. The resultant curve was true along the entire arc. The sharp returns at the ends of the arc, where the walls frame into the columns, were obtained by employing form templates built on an arc with a radius of 3 ft. 9 in.

The water tanks on the roof of the structure are of interest not only because they were built of reinforced-concrete to save steel, but also because of simplicity of line (see photo at right).

The new plant was financed by Defense Plant Corporation under an appropriation of about three million dollars. The prime contractor for design and construction was the Industrial Engineering Co., New York, which furnished both engineering and construction services with its own forces and combined with Lockwood Greene Engineers, Inc., for architectural layout. In charge for Defense Plant Corporation was Merganthaler Linotype Co., New York, with L. G. Mertz, Jr., construction manager, coordinating all phases of the work. The firm of Wolff & Munier, Inc., New York, performed all the air conditioning and heating work.



Since front of building is curved to a radius of 759 ft., transverse spacing of columns varies in first bay. Some of the air-conditioning ducts may be seen in the background at the left.



Reinforced-concrete water tanks on roof of building are located beside penthouse and supported on columns 20 ft. high. In constructing the reservoirs, a 3,000-lb. concrete vibrated in place was used. The floor is slab and beam construction of 8-in. minimum thickness, sidewalls of 12-in. uniform thickness, and roof a 4-in. slab covered by built-up tar and gravel roof.

Fig. 1. Trailer mounted station does preventative maintenance on one of 6,000 pieces of equipment at a Naval Supply depot

Practical Equipment Maintenance

Paul Copenhaver
Assistant Equipment Rental Superintendent, Brann & Stuart Co.

***Contents in Brief**—At a naval supply depot 6,000 pieces of equipment, totaling 25,000 hp., are operated with a minimum of down-time by thorough daily servicing and by rebuilding of worn and broken parts on the work. A complete shop is maintained with equipment available to do any repairing including metallizing, building up by welding, and resurfacing. Besides the time saved, the cost of job rebuilding indicates considerable savings over usual replacement methods.*

IN BUILDING a naval supply depot in Pennsylvania, equipment was called upon to meet the construction hazards of bad ground conditions, rush work and adverse weather. Work started in midwinter in corn and wheat fields and was so scattered, and roads were then so poor that supervisors used saddle horses to get over the job. On part of the work limestone outcroppings added to the difficulties and hazards of equipment operation, resulting in rapid wear and frequent breaking of parts.

Much of the speed on this outstanding construction job was made possible by a comprehensive program of maintenance, repairing and rebuilding of equipment—utilizing the old parts by improvising repairs to give service equal or superior to the original—thus, reducing mechanical difficulties and equipment downtime to a minimum. An unusual system of preventative maintenance was instituted and a complete job shop was installed to service the 6,000 pieces of equipment used on the work. The machines in use range from fractional horsepower motors to the largest construction equipment and total about 25,000 hp. In the interest of speed they were assembled largely under Navy rental recapture contracts, despite the fact that this brought in many makes and all sizes of machines.

Most important in equipment maintenance is servicing the machines so they will require a minimum of repairs or other attention. On this naval depot every machine is serviced, greased and otherwise checked at least once every 24 hr., and more often on some equipment.

This requires concentration of the machines and quick disposal of the laborious detail of cleaning. Each day all items of equipment that are mobile are brought to a field adjacent to the greasing shed. At the end of the first shift laborers do a rough job of cleaning the machines of all excess dirt, grease and mud. The machine is then driven on an inclined timber ramp at the wash rack, where all parts of it can be easily reached, and is steam cleaned and washed down before greasing. This care in washing and cleaning has saved many dollars in wear and is one of the most important steps in preventative maintenance.

Any repairs or adjustments needed are noted by the washers and service men and reported to the greasing foreman who advises his supervisor, the master mechanic, on a form provided for the purpose. It is found that

this thorough cleaning followed by a careful check for breakage and excessive wear has many times prevented the complete failure of a machine by disclosing breakage ordinarily hidden by grease and mud. If breakage is not found and corrected promptly, it often causes progressive damage and failure of not only the parts immediately affected but also associated parts.

The steam plant used for the cleaning of this equipment is made from a used up-right boiler of 50 hp. fired by coal and is supplemented by two steam tank-car heaters. Water for the boilers is supplied from a drilled well and is delivered by a 2-in. electric pump.

Greasing does not mean an ordinary, casual once-over but here is a careful detailed check of many items following cleaning and washing. A greasing log, prepared for each machine, requires that each of the following items be checked off at each servicing. Oil pressure gages are tested, a very important item and one that many equipment users overlook. Oil-bath air cleaners are inspected, washed and filled to the proper mark with light engine oil. Crankcases are checked and brought to the full mark. Oil breathers are washed and serviced daily as are clutch release bearings and water pumps.

Generators and spring trunnions are checked and greased daily. Trackwheel systems are lubricated each shift. Clutch grease cups are given three complete turns each day by the greasing crew, all pressure gun fittings are wiped clean and greased each day and oil gravity cups are serviced on each shift. Oil filters are carefully cleaned and washed at every engine oil change. Fan hubs are lubricated at the time the engine oil is changed.

Once each week transmission oil filters are checked and serviced; transmission cases are checked and kept to the full mark; clutch compartments are inspected and drained of excess oil; oil pan drains are removed and cleaned, distributor grease cups are serviced. Batteries are given a careful hydrometer test and distilled water added as required.

Particular attention is paid to the lubricant used for each of the many requirements on the several types of machines as the proper functioning of any lubrication system depends upon the use of correct materials. Oil and grease must be of such body and character that it will lubricate all working parts at the temperature, pressure and other conditions encountered for the particular machine and part.

A real machine shop

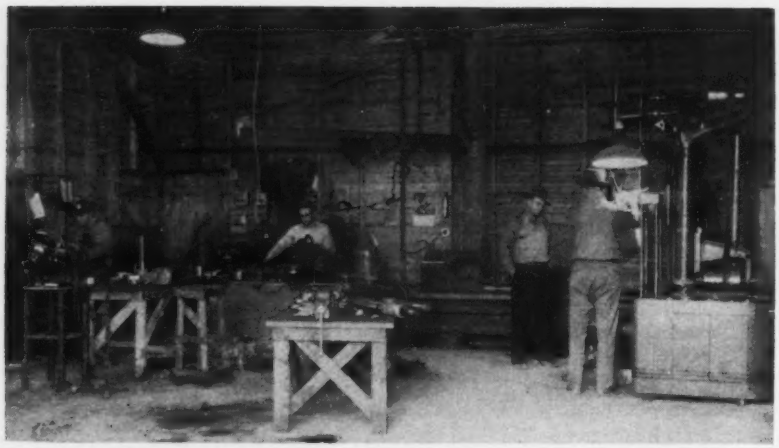
Despite the best of servicing, machines on heavy construction projects often break down and some parts rapidly wear out. Carrying an adequate stock of repair parts for 6,000 machines is not practical and, as considerable time is usually consumed in procuring parts it was necessary that means be provided on the job for making rapid repairs. A completely equipped machine shop was established on the work to rebuild parts as necessary. This shop has all of the machines needed for modern high-class work and has justified its existence not only in reducing the lost time on equipment but by direct saving in repair costs. On this construction job it has been very rare for a machine to be down at any one time for more than a few hours except for a complete overhaul on equipment that has had many hours of continuous work.

Machine repair and overhaul is scheduled through the shop to prevent periods of little work being followed by a rush, but it is planned to always keep the important machines operating. The greasing foreman's notations are used as the basis for scheduling and are consulted as the machine goes through the shop. Repairs to break-downs are given precedence over routine repairs and the usual work is scheduled so that men can be detailed to a rush job.

Rebuilding, really re-manufacturing, of parts has been developed to a rather high degree on this work. Items such as excessively worn track wheels are brought oversize by welding and then turned or ground to the correct size. Where excessive wear has occurred on one particular spot, as at a grease seal or bushing location on shafts or axles, the damaged part is undercut and trued in a lathe, then scored and built up by welding or metallizing and finally machined to the correct size.

Metallizing, the spraying of molten

Fig. 2. Tractors operating in mud get thorough steam cleaning daily, ahead of servicing. Wood sled was adopted to save dragging trucks through deep mud, and is said to have saved $250,000 in material handling and machine costs.



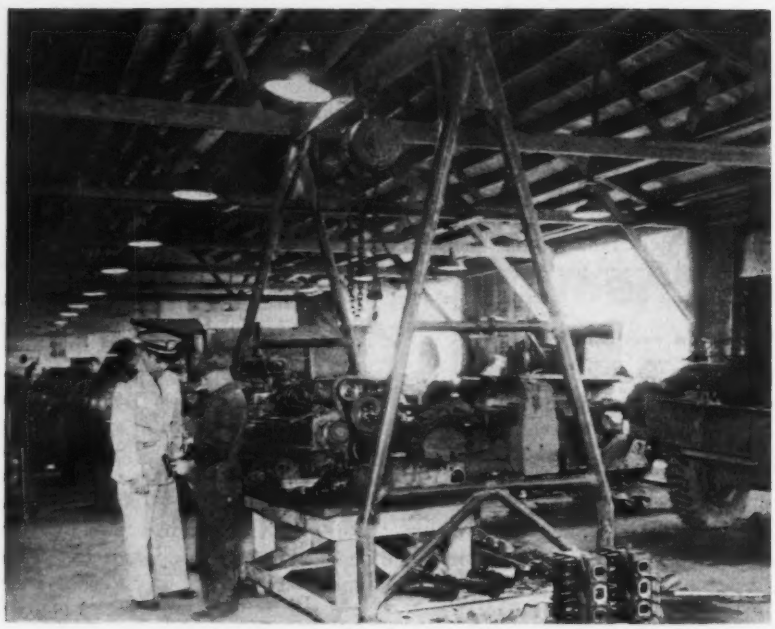


Fig. 3. Interior of the machine shop. The portable motor-lift below is job made.

metal for rebuilding parts, has become one of the most important processes used in the project maintenance shop. It does not take the place of rebuilding by arc welding but rather, is used with it, though in some cases one or the other may make a better repair if used alone.

The piece to be metallized is usually undercut a small fraction and trued, then grooved and scored and finally cleaned by the use of an abrasive blast. The machine for this work can be made in the project shop. Care should be taken after blasting that no oil gets on the work, either by handling or through the air supply. After cleaning, molten wire is sprayed, from a special metal spray gun, on the worn part and this section is then machined to the finished size desired.

Many metals can be sprayed by this method: iron, steel, stainless steel, tin, monel metal, nickel, zinc, lead, bronze, copper, brass, aluminum and babbit are often used. Some of the parts on which a practical job of this kind can be done are motor armature shafts, pump pistons, sleeves, scored shafts, axles, crankshafts, camshafts, pulleys and worn wheel and bearing bores—items difficult to rebuild by any other method.

Metal sprayed shafts, crankshafts, and other moving parts often have better performance characteristics than new parts—wearing longer and standing greater abuse—the sprayed surface naturally holding lubricants by absorption. This process may also be used to spray outside surfaces to prevent oxidation or, with special materials, apply an insulator or non-conductor.

It is believed that the possibilities of metal sprays have only been partially developed so far and that research will bring to light almost fantastic uses of this equipment in the future, not only in the maintenance shop but in the manufacturing field as well.

Many other repair jobs are done in the machine shop. Bushings are turned oversize and to the correct tolerance to allow for wear. Broken or worn gear teeth are repaired by welding and re-machined. Damaged crane booms are heated, straightened, and, after stress relieving, are braced and welded.

In addition to the regular repairing and adjusting program equipment is fabricated, installed, altered and rebuilt in the machine shop. Considerable hard-facing is done on cutting edges and surface parts exposed to excessive wear such as dipper teeth, bucket sides and bottoms and mixer blades. The shop crew makes special machinery adaptations for rippers, scrapers, graders, cranes, light plants and other items of equipment. They reclaim defective castings by welding and machining; build up worn wheels, pulleys, clutch throwout fingers, chain links and pins.

Some shop suggestions

Cutting edges, both new and used, are built up by welding with a nickel steel wire binder followed by an abrasive wire on the second and third bead to give a harder and longer-wearing surface to the important cutting edges of excavating machines, thus eliminating a large inventory and the time necessary for manufacture of a complete unit. Worn holes in plates are filled by melting boiler-punchings in the holes and then redrilling. In some cases a finished hole is made by welding around brass rods of the diameter desired as material deposited by electric welding does not readily adhere to brass.

The machine shop turns out jobs on the project site that under other conditions would be sent out, requiring special transportation and the services of a highly specialized shop that

CONSTRUCTION SHOP EQUIPMENT

- Molten metal spray gun for metallizing
- Heavy-duty lathe, 36-in. swing 18-ft. bed (originally shaft driven but converted to 10 hp. motor)
- Gear-head lathe, 20-in. swing, 8-ft. bed, 5-hp. motor
- Step-toe shaper 20 x 26-in. bed, 2½-hp. motor
- Drill press, 4 speed V-belt drive ½-in. chuck, 12-in. table, 40-in. drop
- Drill press, 8-speed 1½-in. chuck, 18-in. table
- Drill press, 38-in. table
- Threading machine, for pipe 2-in. dia. maximum
- Power saw, 6-in. throat
- Bench Grinder, 10 in.
- Two 300-amp. electric arc-welders
- Ten 200-amp. gasoline driven arc-welders
- Two portable compressors
- Portable motor lift on casters
- Electric drill stand, valve grinder, brake reliner and grinder, vulcanizers chain hoists, melting-pot, armature testers, battery chargers, electric instruments and analyzers

derstands equipment and equipment repairs. Such shops are usually located only in the larger cities, often far from construction jobs. By handling the work in the project shop much time and expense is saved and a repair or replacement secured that is very superior to that which is turned out by the average job-shop.

Compared to the cost of replacement parts for equipment, almost unbelievable savings are made. For example: tractor and shovel axles and shafts, costing from $36 to well over $100, are built up by welding and turned to size at the shop at a cost in time and material of less than 30 percent of the amount required for replacement.

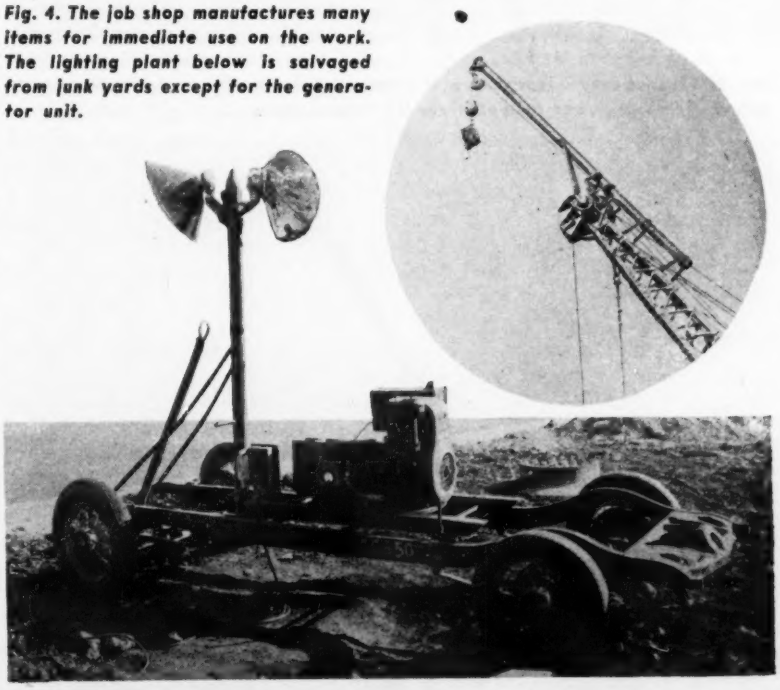
Far more important to the Navy and the contractor than cost, however, is the great saving of time in a period of emergency such as we are now facing. This use of welding, metallizing and machining cuts necessary spare parts inventories to an absolute minimum, thus making available many parts and manufacturing facilities than can be used for the construction of new machines. This in itself should be a widely practiced and most important phase of assistance to manufacturing production in today's emergency.

Machines made for the work

A number of machines have been built or, perhaps more accurately, assembled at the job shop for use on the work. Typical of this equipment is the portable light plant in Fig. 4. These units are mounted on a four wheel auto chassis made into a trailer with a low tongue, machined and fastened to a plate on the front axle to turn the tie rod, using the front axle as a fulcrum. A gasoline-engine driven generator is mounted in the center of the chassis and a light standard of 12 to 15 ft. of used pipe is welded to the frame and braced to support two to four floodlights fastened at the top. This handy, portable unit enables the equipment dispatcher to shift the lighting equipment quickly and easily each day by use of a small utility tractor. Pipe laying rear cranes, designed for mounting on crawler tractors, are built from used pipe and are operating very satisfactorily, utilizing the standard tractor winch for power.

A practical idea that has saved much time is the use of low sleds, built of timber, for the transportation of lumber and other material under the very adverse weather conditions encountered, which made the project a mass of mud and difficult to operate trucks for hauling. These sleds, intended for pulling by large tractors, were designed and built in the shop making possible quick, efficient transportation and easy, fast loading and unloading of the thousands of cars of construction material used on the job. Use of the sleds on this work has reduced the number of trucks necessary by over a hundred with resultant saving in rubber, metal, gasoline and oil, and in addition has reduced the time and money cost of material handling by almost one-third. It is estimated that this means of handling material, suggested by the construction superintendent, has saved over a quarter of a million dollars in equipment cost and maintenance.

Fig. 4. The job shop manufactures many items for immediate use on the work. The lighting plant below is salvaged from junk yards except for the generator unit.



No overloading

Equipment on this work is not permitted to carry loads in excess of its rated capacity nor are motors overspeeded. Equipment operators are required to handle their rated horsepower load without "bulling" the load or slipping the clutch to gain momentary excessive power. Cranes are used to carry only the loads they were designed to handle and unusual boom lengths or heavy counterweights are not permitted. Tampering with engine governor seals is prohibited and the machines are operated at a speed

of as much as ¾- to ⅞-full throttle.

Overloading and overspeeding are not tolerated as they cause excessive strains throughout the machine that will cause wear and breakage. As long as machines are allowed to handle the loads they are built for — that is, whatever they will handle in the gear in which the machine is operated—and are not abused, excessive wear will not occur. This is shown by the fact that one operator can take a machine such as a 100 hp. tractor and operate it for a period of from one to three years under normal conditions with very little maintenance. Another operator who attempts to force or abuse the machine will have a maintenance cost and down-time charges over the three-year period that might amount to as much as the original cost of the machine.

Only operators who have a knowledge of the type of equipment they are to handle and who are trained in the practical use and adjustment of the equipment are employed. It is necessary for the operators to know the limits, balance, and weakness of the machines that they use and they must have the practical, everyday common sense that enables them to get the most out of a machine with a minimum of effort and cost.

Experience on this naval depot in the daily maintenance of 25,000 hp. of construction machinery indicates that careful preventative maintenance, an adequate and properly supervised machine shop and insistence on well trained operators will keep all of the equipment ready to work practically all of the time. Many of the practices used here are applicable to the operation of one machine as well as to several hundred. Especially now, when new materials are scarce, it is a patriotic necessity to get the most from every machine and to repair rather than replace parts and machines.

Fig. 5. Dipper teeth are built up with abrasive welding rod making them fully as good as new and generally more resistant to wear.

Fig. 6. This job-made rear crane is controlled by the regular tractor winch operated from a power take-off from the tractor motor.

Personnel

The naval supply depot is being constructed under the supervision of Lt. Comdr. H. D. Martin (CEC), as officer in charge of construction for the Navy under the Bureau of Yards and Docks.

Contractors for the work are Brann & Stuart Co., of Philadelphia. H. B. Madden is project manager assisted by George Strecker. Charles Hartline is utility superintendent and has complete charge of all excavation, grading and equipment, including operators. William Kliefoth is construction superintendent and Tom Barrett is master mechanic in charge of the shop work. That this organization has set a high record for outstanding construction is evidenced by the award of first place efficiency pennants in competition with 51 other public work projects.

Vacuum Flotation

A NEW PROCESS FOR SEWAGE AND INDUSTRIAL WASTE TREATMENT

A. J. Fischer Development Department, The Dorr Co., Inc., New York, N. Y.

***Contents in Brief**—Grease and difficult-to-settle solids in sewage may be removed prior to sedimentation by means of a new process employing principles of vacuum flotation. The process can be applied also to the treatment of cannery and oil refinery wastes to produce results that may eliminate the need for any further treatment before discharge. Design and operating principles of the process mechanism, called a "Vacuator", is described, along with pilot plant and other tests.*

DEVELOPMENT of a process employing principles of vacuum flotation has advanced to the point where it can be considered as a valuable adjunct in the treatment of both domestic sewage and industrial waste. Prime objective of the flotation process is to remove grease and light difficult-to-settle solids prior to clarification.

Laboratory and pilot plant experiences have resulted in the design of equipment to apply this process, twenty-one units of which are either operating or being installed at municipal and industrial establishments.

Behind the development of vacuum flotation is the fact that suspended solids in practically all domestic sewages and many industrial wastes contain a light fraction that either tends to float or is difficult to settle. Many factors affect the amount of this light fraction, the principal ones being: Specific gravity, particle size, grease content, age of the solids, pH value and presence of entrained gas in the sewage.

In conventional sedimentation units the floating material or scum is removed usually by a skimmer while the settled sludge is raked by a mechanism to a suitable discharge point. The effluent discharged contains the suspended matter that neither settles to the tank bottom nor floats to the surface. Often it also contains a considerable amount of scum that is forced down below the scum baffle by disturbances due to the skimmer or to wind action.

All types of skimmers leave much to be desired, although some may be more efficient than others. Their use is often futile when large amounts of scum are continuously forming in a settling tank, such as when packinghouse and cannery wastes are present, or where the sewage is pre-aerated for release of grease.

To maintain a clarifier surface substantially free of scum, preliminary removal of scum-forming substances is desirable in some cases. This led to the development of pre-aerators of various types. It was soon found, however, that such units did not remove but merely aided in the partial release of grease ahead of and in the clarifier tank. They did not materially increase the overall removal of suspended solids unless extremely long aeration periods were employed. Actually, some pre-aerators, due to their violent action, break up sewage flocs that would normally settle and so reduce the actual removals effected.

It soon became apparent that in order to efficiently remove scum and light suspended matter from sewage, without adversely affecting subsequent sedimentation, a separate step would have to be provided ahead of the settling operation. Vacuum flotation appeared to offer the best possibility, as this process utilizes to advantage those factors that normally interfere with settling.

Vacuum flotation principles

When a liquid is aerated, the larger air bubbles rise rapidly and escape to the atmosphere while the finely divided air liberates itself very slowly at ordinary pressures. If the liquid is subjected to a vacuum immediately after the large bubbles have escaped, the minute bubbles are released rapidly in a very fine form and attach themselves to light, suspended solids particles. This causes the solids to be lifted to the surface from which they may be readily removed.

The unit in which this flotation action is accomplished has been termed a "Vacuator." The process, or system, involves three steps: (1) aeration; (2) de-aeration; and (3) use of the Vacuator.

Aerator—In order to obtain the maximum flotation of solids, it is necessary in most cases to pre-aerate the feed prior to its introduction into the Vacuator tank. In some cases this step might be omitted as there may be sufficient entrained gases present in the sewage to effect the removal of sum-forming material.

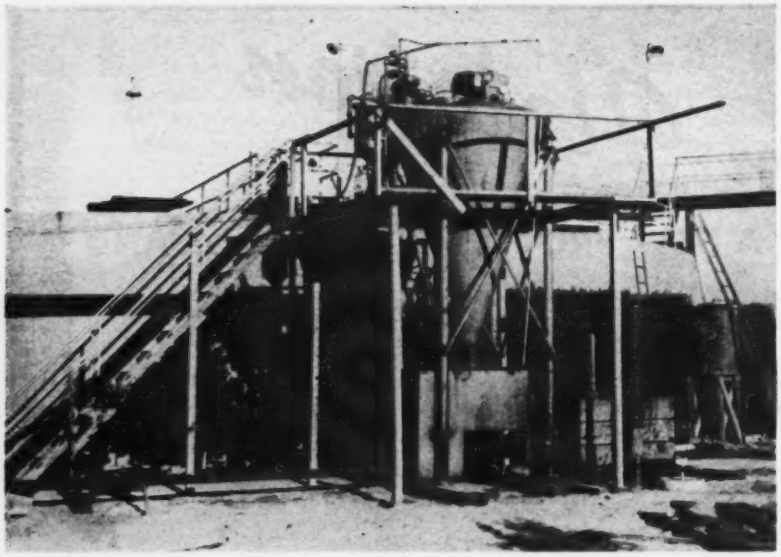


Fig. 1. Pilot-plant installation of a Vacuator used in the Los Angeles tests.

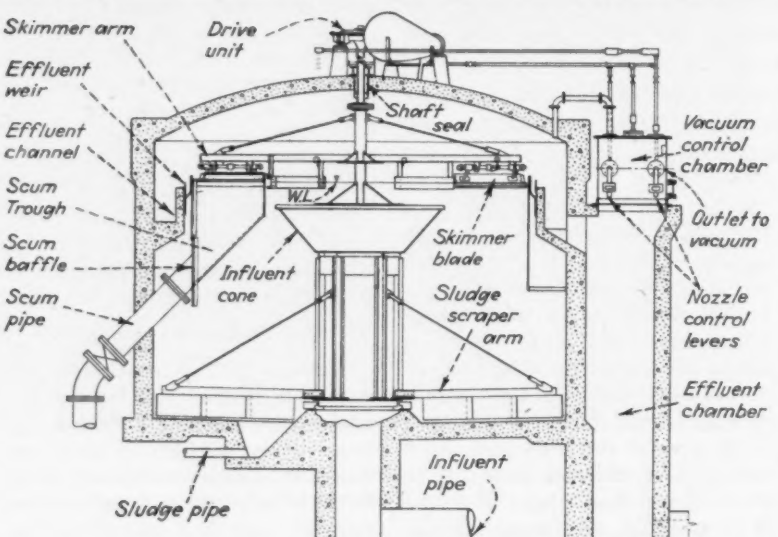


Fig. 2. Vacuator of the "constant-level" type. The cylindrical tank with a dome-shaped cover is under a constant vacuum of about 9 in. of mercury. Sewage enters a central draft tube from which it is distributed by means of a flared-top section. Floating solids, bouyed up by fine air bubbles, are skimmed from the liquid surface and carried to a trough. Settled solids are removed from the bottom with a scraper mechanism.

Conventional types of air diffusion or mechanical aerators may be employed. For best results it is desirable to aerate rather violently so that a maximum amount of finely divided air bubbles are entrained. Units such as are regularly used in flotation work in chemical and metallurgical fields are in commercial use and have been proved to be very effective.

The amount of air required for ordinary conditions is estimated to be 0.025 to 0.05 cu. ft. per gallon of sewage or waste treated. The aeration period provided at average flow may be as low as 30 sec.

De-aerator—The purpose of de-aeration is to release the larger air bubbles before the aerated material goes to the Vacuator. If this is not done the large air bubbles present would cause undue surface disturbance. This would result in the detachment of the small air bubbles that float the light solids with a consequent lowering of flotation efficiency.

De-aeration takes place very rapidly and may be readily accomplished in a few seconds by passing the aerator effluent through a small compartment, connecting channel or tank, which acts as a feed chamber for the Vacuator.

Design of Vacuator

As shown in Fig. 2, the Vacuator consists of a cylindrical tank with a dome-shaped cover. In the tank which may be either steel or concrete a vacuum of about 9 in. of mercury is maintained.

The feed enters the tank through a central draft tube, from which it is distributed by means of a vertical flared-top section close to the liquor surface. Floating solids buoyed up by the fine air bubbles collect on the surface from which they are continuously removed by means of a skimmer; the skimmer moves the scum around to a trough, the top of which is slightly higher than the liquid level. The skimmer blades are hinged to two or more radial arms so arranged that they permit the blades to push the scum up a ramp to the trough. From here the scum discharges continuously by way of a barometric leg.

The effluent passes under a circular baffle and discharges over a weir into a peripheral effluent channel. From this channel it flows to a seal chamber, a barometric leg again being used to permit continuous gravity discharge against the vacuum.

Coarse solid particles that settle out are raked to a central sludge outlet by means of a bottom scraper mechanism that rotates with the skimmer. As in the case of the scum and effluent outlets, the sludge outlet also must be sealed off to prevent the loss of vacuum.

In the design shown (Fig. 2), the vacuum in the unit is automatically maintained constant by means of a control chamber connected to the effluent launder. An adjustable pipe in the chamber is connected to a wet vacuum pump. The open end of the pipe is set at a point slightly below the elevation of the top of the overflow weir. If the vacuum tends to rise, the liquor levels in the effluent barometric leg and the effluent channel also rise. As the liquid seals off the open end of the vacuum pipe, the

pump draws water until the vacuum again drops to a point where the end of the vacuum pipe is just above the water level.

Due to the peripheral overflow weir the liquid level in the main tank cannot rise even though the vacuum is increased unless the effluent channel first fills up and the overflow weir becomes submerged. Because of this characteristic, this design has been termed the "constant level" type.

A modified design of Vacuator, termed the "variable level" type, also is in use. Here the effluent is taken off through bottom tank outlets, and the vacuum control chamber is connected hydraulically to the main body of the tank. The adjustable vacuum pipe in the control chamber serves to control the liquid level in the unit proper, so that it bears a fixed relationship to the top of the scum trough. Here again as the liquid rises above the open end of the vacuum pipe it seals off the air and liquid only is pumped. As the liquid level drops below the vacuum pipe, the pump again draws air from the space above the liquid, thus increasing the vacuum and causing the liquid to rise.

The "constant level" design is preferred where the scum is fairly solid or viscous and can readily be raked up the scum ramp, and when it is desired to remove heavy settleable solids as well as flotable solids from the liquid being treated. Typical applications are for the pre-treatment of raw sewage for scum and grit removal ahead of clarification, and for the treatment of cannery wastes.

The "variable level" design is better adapted to conditions where the floating material to be removed is very light or cannot readily be raked up a ramp. The treatment of oil refinery waste waters is a typical case.

The manner in which the system is operated is revealed by Fig. 3, which shows a flexible aerator, de-aerator and Vacuator arrangement.

Raw sewage enters compartment A and flows to the aerator tank over the adjustable sill 1. Aerator effluent passes over the adjustable sill 2 into the de-aerator B from which it flows to the Vacuator. Vacuator effluent flows to the seal compartment C, and from here the flow passes on for further treatment.

Stop planks at the top of the division walls 3 and 4 between compartments A and B, and B and C may be so adjusted in height that excessive flows will be automatically by-passed around the aerator or Vacuator tanks. The arrangement also permits complete by-passing of either or both units. It will be noted that sufficient liquid depth is maintained over the Vacuator feed and effluent pipes F and E so that it is impossible to cause a sudden drop in vacuum in the Vacuator tank due to the admission of air at either point. The volumetric holding capacities of compartments B and C are at least as great as the capacities of pipes F and E, respectively.

The elevation of the Vacuator floor is about the same as that of the water level in the aerator. The water level in the Vacuator, therefore is 10.25 ft. higher, this being equivalent to the 9 in. mercury vacuum maintained in the unit. The actual loss-of-head is equal to the friction loss in the feed pipe and the loss over the effluent weir. Normally, this head loss should not exceed 6 to 9 in.

Probably the best way to visualize the hydraulic operation of the Vacuator is to consider it as a closed siphon. It will then be apparent that the liquid flows by gravity through the entire system and that pumping is not required. The only power required to maintain the high water level, once the tank is filled, is that for exhausting the air liberated in the unit. For a 20 ft. dia. tank operating at a 10,000 gal./sq.ft./24 hr. overflow rate, this amounts to only about 0.5 hp. per million gallons of liquid treated.

Studies in the laboratory

Laboratory studies to demonstrate the efficiency of vacuum flotation in the treatment of sewage and various types of industrial wastes were made with the apparatus shown in Fig. 4.

The sample is introduced into the separatory funnel and aerated by violent shaking for about 30 sec. The funnel then is supported on a ringstand and the desired vacuum applied for two to three minutes through connection B, pinch clamp 1 being closed. The degree of vacuum is adjusted and maintained by regulating the screw clamp on a connection open to the atmosphere. Pinch clamp 2 is then closed. The vacuum in the cylinder is then raised slightly by closing down on the screw clamp. Pinch clamp 1 is then opened. This draws a sample over from the funnel to the cylinder.

The first portion drawn over is discarded, tube A having been filled up with water at the start of the test to prevent air from being pulled back

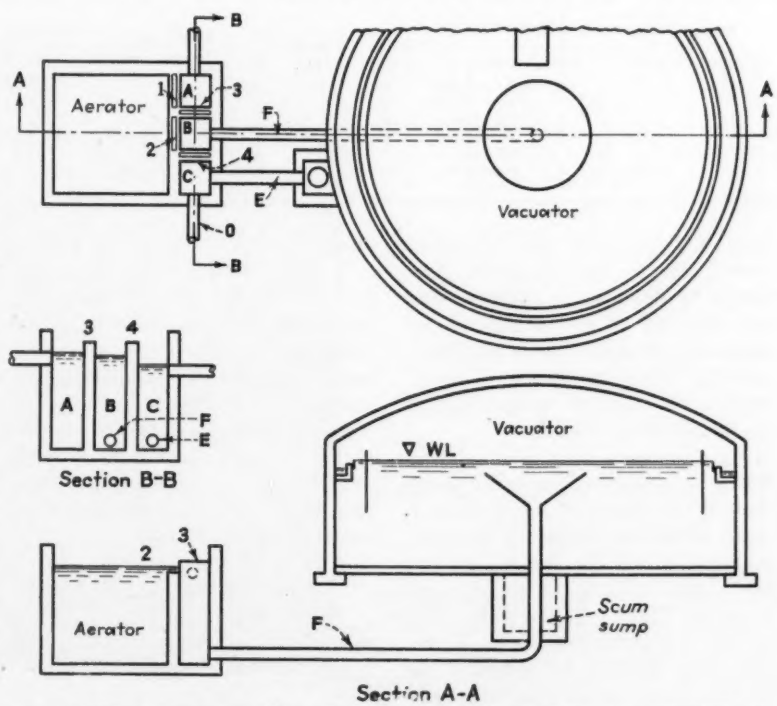


Fig. 3. Typical vacuum flotation installation, which consists of an aerator, de-aerator and Vacuator

TABLE I—LABORATORY TESTS OF VACUUM FLOTATION ON RAW SEWAGE SHOWING THAT THE LIGHT SOLIDS FRACTION IS READILY FLOATED.

Sewage	Coagulant Added: Kind	Coagulant Added: ppm.	Suspended Solids — ppm.: Influent	Suspended Solids — ppm.: Effluent	Percent Removal
A	None	..	483	223	53.8
	$FeCl_3$	34	483	140	71.0
B	None	..	580	168	71.0
	$FeCl_3$	17	580	80	86.8
	$FeCl_3$	30	580	39	93.3
	$FeCl_3$	43	580	28	95.2
C	None	..	516	141	72.7
	$FeCl_3$	44	516	20	96.1
D	None	..	58	39	32.8
E	None	..	200	115	42.5
F	None	..	340	135	60.3

TABLE II—LABORATORY TESTS ON VARIOUS TYPE OF CANNERY WASTES SHOWING REMOVAL OF SUSPENDED SOLIDS.

Material	Influent	Effluent	Percent Removal
Tomatoes	4,105 ppm.	100 ppm.	97.7
Pears	2,175	270	88.5
Asparagus	1,050	140	87.2
String Beans	1,195	165	86.6
Spinach	1,034	240	78.7

TABLE III—RESULTS OBTAINED WITH CONTINUOUS VACUATOR OPERATION IN A PILOT PLANT INSTALLATION TREATING DOMESTIC SEWAGE CONTAINING INDUSTRIAL WASTE.

Type Aeration	Overflow Rate Gals. Sq. Ft. 24 Hr.	Detention Period Min.	Suspended Solids—ppm.: Influent	Suspended Solids—ppm.: Effluent	Percent Removal	Percent Solids in Float
None	1,610	20.3	544	343	37.	4.2
None	2,440	13.5	438	286	34.7	5.6
None	11,700	20.8	367	320	12.8	7.3
Diffused Air	4,840	6.9	450	228	49.3	7.3
Diffused Air	11,700	2.8	357	294	17.6	7.5
Mechanical	1,610	20.3	544	265	51.3	4.5
Mechanical	2,440	13.5	524	286	45.4	5.6
Mechanical	4,840	6.9	406	244	40.2	7.7
Mechanical	9,100	3.6	414	262	36.6	8.4
Mechanical	11,700	2.8	381	234	38.5	7.5

TABLE IV—PILOT PLANT VACUATOR TESTS ON THE TREATMENT OF OIL REFINERY WASTE WATER

Test No.	Overflow Rate Gal./Sq. Ft. 24 Hr.	Detention Min.	Feed	Caustic Added	pH Value: Infl.	pH Value: Effl.	Oil—ppm.: Infl.	Oil—ppm.: Effl.	Percent Removal
1	1,650	20	Raw Waste	Yes	2.4	6.0	3,000	14	99.5
2	3,300	10	Raw Waste	Yes	2.3	8.0	930	24	97
3	6,600	5	Raw Waste	Yes	2.4	5.9	850	38	96
4	6,600	5	Separator Effluent	Yes	1.9	5.4	86	5	94
5	6,600	5	Separator Effluent	No	2.6	2.7	88	23	62.5

from this tube into the separatory funnel. In this way an undisturbed sample is obtained for analysis without shutting off the vacuum in the separatory funnel. This is absolutely essential since the shock of interrupting the vacuum causes some of the floated scum to settle.

Raw Sewage—Tests on raw sewage at a number of treatment plants showed that the light solids fraction could be readily floated in all cases. Some typical results with and without coagulation with ferric chloride are given in Table 1. These tests were all run at 9-10 in. vacuum for 3 min. following aeration by agitation for 30 sec. These conditions were indicated to be optimum, as is shown by test data on a typical domestic sewage that are plotted in Fig. 5.

In these, as well as all other test data presented, suspended solids tests have been used as a measure of performance because no acceptable method of determining flotable solids has yet been developed.

Cannery Waste—Tests on a variety of cannery wastes indicated suspended solids removals ranging from 79 to 98 percent. A typical test on tomato waste showed the following:

Fraction	ppm. Sus. Solids	Distribution of Solids—%
Feed	4,105	100
Float	50,000	91.3
Sludge	.....	6.4
Effluent	100	2.3

It will be noted that most of the solids removed appeared in the float. This same characteristic was indicated with spinach waste. In the case of pear and string bean waste, the ratio of suspended removed as float to that removed as sludge was about 1:1. In the case of asparagus waste, it was 1:3:5. Results of tests on various materials are given in Table 2.

Pilot plant experiences

In order to determine the effectiveness of vacuum flotation on a continuous flow basis, a 7 ft. dia. Vacuator was constructed and tested on sewage at the Los Angeles Terminal Island plant and on oil waste at a West Coast refinery (Fig. 1). Operation of this unit resulted in the establishment of basic factors used in the design of the commercial unit.

Raw Sewage—At Terminal Island raw sewage was diverted from the feed line to the primary settling tank so that comparative studies could be made. Observations were made and data collected at various overflow rates and detention periods. Different methods of pre-aeration were also studied. The effect of the Vacuator pre-treatment on subsequent clarification also was noted.

Average results from daily tests on 24-hr. composite samples are summarized in Table 3. During this test period the sewage contained a considerable amount of industrial waste. Occasionally a large amount of fish wastes was present.

These data show that a relatively high percentage of the light suspended solids were floated even at very high overflow rates and low detention periods. Results were measurably improved with diffused air as against no preaeration. Short period intensive mechanical aeration obtained with a flotation type aerator gave far better results than did air diffusion at the higher overflow rates. At an 11,700 gal./sq.ft./24 hr. Vacuator overflow rate, the aeration period employed was only about 10 seconds. Of special interest is the high percentage of solids in the float.

Observations showed a complete absence of scum when the Vacuator effluent was post-settled. Laboratory tests on the raw feed and on the Vacuator effluent indicated that greater overall suspended solids removals could be obtained when Vacuator treatment preceded clarification than when settling alone was employed.

A number of grease determinations were made by Mr. Wakeman of the Los Angeles Harbor Testing Laboratory. Some inconsistencies were noted due probably to the varying quantity of "free grease" in the sewage. The trend indicated, however, that grease removals closely followed suspended solids removals. Apparently, if high grease removals are desired, the grease should be present as "free grease." The quantity of "free grease" present depends on the character of the sewage and may be increased by acidification or prolonged aeration.

Oil Refinery Waste—In the treatment of oil refinery waste water, the same set up was used as was employed at Terminal Island, except that preaeration was obtained by pumping the feed through an injector. Continuous runs were made on raw waste and on partially treated effluent from a main oil separator tank. The effect of addition of flocculating agents such as ferric salts, alum and caustic soda was determined on both materials.

In Table 4 is summarized results of oil removal obtained in some of these tests where no coagulant was added but where the pH value was adjusted by the addition of caustic soda. All tests were made on composite samples. In general the Vacuator was found to produce results superior to these obtained in the main oil separator tanks at overflow rates approximately fifty times those used in the latter units.

When treating raw waste it was found that the lowest effluent oil, asphalt and suspended solids were obtained at pH values between 6.1 and 8.6. Best removals were obtained at 10 to 20 min. detention, regardless of the pH value. The addition of flocculating agents decreased the removal of oil and asphalt, but did not affect the suspended solids removals.

With partially clarified waste, best removals of oil and asphalt were obtained at 10 to 15 min. detention. With no flocculating agent added, the highest removals of oil and asphalt were obtained at pH values between 3.6 and 8.2. Improved suspended solids removals were obtained at the lower pH values.

In general, iron salts gave better oil and asphalt removals than alum although the latter appreciably reduced the effluent turbidity. Suspended solids reductions were not appreciably affected by the addition of either alum or iron salts.

Plant installations

At present 21 Vacuator installations are in operation or being installed for use in 14 plants. Two of these units are for use in treating cannery wastes, four for pre-treatment of sewage, and the remainder for recovering fine particles of rubber from waste water in the manufacture of synthetic rubber. The units range in size from 4.5 to 40 ft. in diameter.

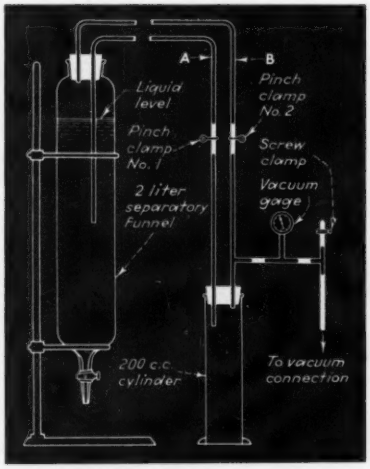


Fig. 4. Laboratory set-up for making vacuum flotation studies

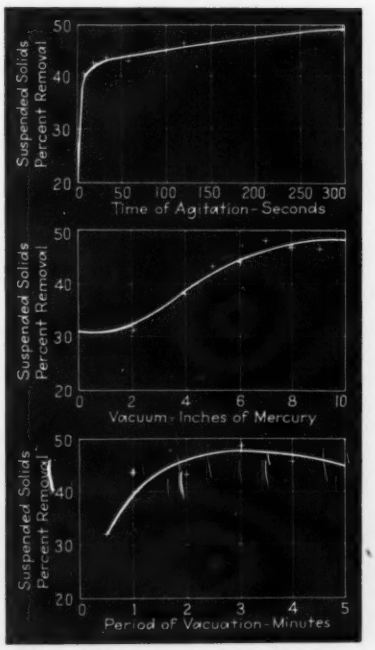


Fig. 5. Suspended solids removal results under varying conditions of agitation (aeration), vacuum and vacuation

The largest sewage plant installation is that at San Diego for skimming raw sewage ahead of clarification. Here two 35 ft. dia. Vacuators are designed to handle an average flow of 20.6 mgd and a maximum flow of 31.9 mgd.

So far, only four plants have been placed in regular operation, two on cannery waste and two on domestic sewage. At one of the latter plants a heavy seasonal load of cannery waste is discharged to the sewer system. Catch samples and visual observations indicate that all of these units are operating in a satisfactory manner.

Summary

The development of vacuum flotation is now far enough along that the process can definitely be considered as a valuable adjunct in the treatment of sewage and trade wastes. In sewage treatment the process is intended solely for use in removing scum and light, difficult-to-settle solids prior to clarification.

The use of a Vacuator for both scum and grit removal appears to be especially attractive as the area requirements for floating grease and light solids is about the same as those for settling out heavy particles of grit. Another application that may be particularly attractive for large plants is the use of the unit for concentrating dilute skimmings removed from clarification tanks.

In many industrial waste problems such as the treatment of cannery and laundry wastes and oil refinery waste waters the process should serve to provide sufficient treatment so that the waste may be discharged to a municipal sewer system, a secondary treatment system, or a receiving body of water.

The design of the Vacuator and its application to the sanitary field originated with the Los Angeles staff of The Dorr Co., Inc. The program of investigation described in this paper was carried out by the Development Department of the company in cooperation with the staffs of the Los Angeles office and of the Westport Mill laboratory.

The assistance of H. G. Smith and his associates in the Los Angeles Department of Sewers, and of the operating personnel at the Terminal Island Sewage Treatment Plant is greatly appreciated.

Industrial Buildings of Precast Concrete

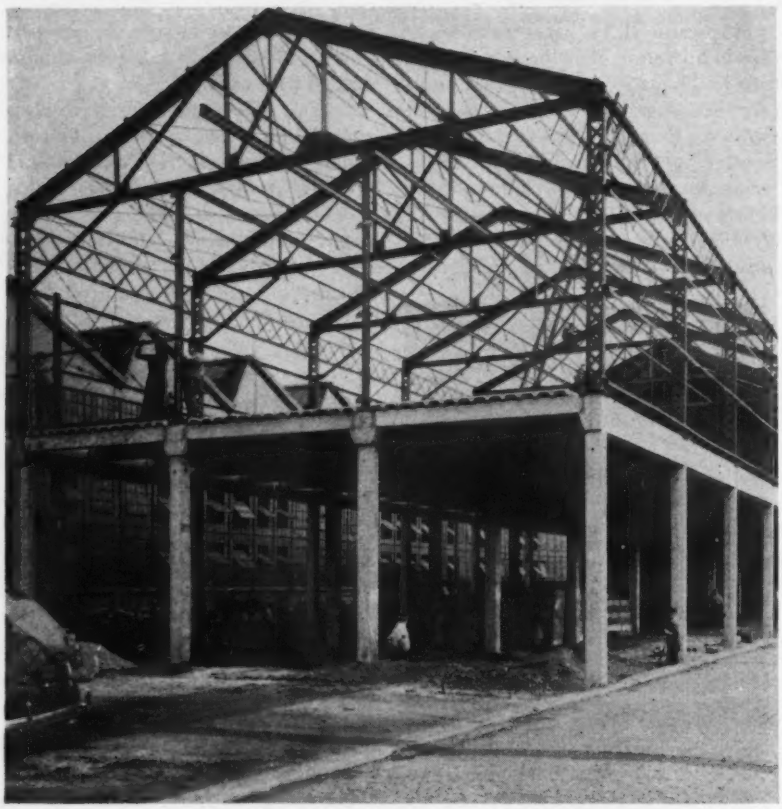


Fig. 1. Precast, reinforced concrete columns, girders, beams, and floor slabs were used to effect a 60 percent steel saving on the first story of this industrial plant in the Pittsburgh area

***Contents in Brief** — Now under construction in the Pittsburgh area are industrial buildings with all members of precast reinforced-concrete. Columns, girders, beams, wall panels, and floor and roof slabs are cast at a central yard and delivered to the job ready for assembly. Shapes have been developed which require few forms, and all the connections for the framing have been standardized.*

WHAT IS BELIEVED to be an innovation in American industrial building construction has been introduced with the use of precast, reinforced-concrete members for the frame, walls, floors, and roof of several buildings now being built at Pittsburgh, Pa. Not only is a 60 percent steel saving possible when the designs are compared with steel-frame structures of the same general layout, but many other advantages are claimed, including several that would make precast building more satisfactory for some layouts even when steel is plentiful.

Biggest advantage claimed for the concrete structures over a steel design is that the latter often requires costly fireproofing, which takes time to install, while the precast members, with fireproofing included, can be erected as fast as the structural steel framework.

Furthermore, the structural framing generally will require paint or some other type of protective covering where fireproofing is not required. In contrast, the concrete surfaces can be made sufficiently smooth and attractive as to require no plaster or paint. It is also stated that by the use of high-early-strength cement the precast concrete members can be manufactured and delivered within a few days, while deliveries of structural steel might take several weeks.

Precast concrete also is believed to have many advantages over fieldcast concrete. First, no field forms are required, and placing operations can be faster and more rigidly controlled, thus cheaper. Also use of large supplies of form lumber, now difficult to obtain, are unnecessary. Little auxiliary heating is required for winter construction with precast material as it is fabricated in an enclosed area and can be stored compactly. In addition, shrinkage occurs in a precast member before it is erected and allowance for this action can thus be made in advance of erection. Furthermore, little, if any, debris will be created on the job.

First use of precast members

The first use of the precast reinforced-concrete members was for an industrial plant where an existing one-story steel-frame structure is to be utilized as the second story of a two-story building with a machine shop on the first floor and lumber storage on the second. How this is being accomplished is illustrated in Fig. 1, which shows the steel structure re-erected on a one-story frame of precast concrete members. The column spacing is 15 ft. by 20 ft., the clearance on the first floor is 15 ft, and the design load for the second floor is 175 lb. per sq. ft. The foundation soil is clay, and a bearing pressure of 5,000 lb. per sq. ft. was permitted.

Cast at a central yard

Manufacture of the precast members is carried out in a 120x200-ft one-story plant 1½ miles from the site. The concrete is prepared by a 1-yd. stationary mixer, a 1:1½:3 mix is specified, and high-early-strength cement is used. This mix makes possible a concrete with a strength of 5,000 psi. in 48 hr. The concrete is delivered to the forms by a 1-yd side-dump bucket handled by an overhead electric crane. The steel rein-

forcing is placed in the forms by hand.

Each column is cast with a flared base penetrated by four 1¼-in. dia. holes for 1-in. dia. anchor bolts set in the 1-ft. thick by 5-ft. square footing. The columns are 12-in. square and they are reinforced with four ¾-in. dia. longitudinal bars and ¼-in. ties every 12 in.

In manufacturing the columns, concrete forms of the type shown in Fig. 6 are used. It should be noted that where the top and bottom forms join, the columns are slightly thicker than at the edges. Such an arrangement permits easy removal of the columns, as there is no chance for the member to bind in the form. It also should be noted that the forms are very sturdy to permit reuse for steady production and that all the corners are rounded to avoid sharp edges that might be chipped.

Columns of many sizes possible

Although only one column size was used in the building illustrated, three sets of forms are available to permit construction of columns in three widths—12, 14, and 16 in. By adding sufficient fillers between the upper and lower forms, it also is possible to increase the depth as desired. For example, with the 12-in. forms, not only are 12x12-in. members constructed but columns of 16, 20, and 24 in. depths may be cast as well. Thus, by increasing both the cross section of the column and the size of the reinforcing bars, it is possible with little trouble to provide for larger loads.

In curing the columns, as with the other members, the exposed concrete is kept moist with burlap bags for 24 hr., and then columns are removed from the forms by a gantry crane and submerged in water for another 24 hr. No further treatment is considered necessary upon removal of the members from the bath.

Depth of girders varied

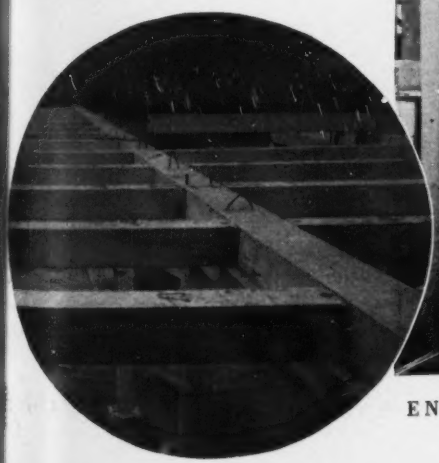
The girders on the project here illustrated are 16 in. wide and 24 in. deep. Concrete forms similar to those for the columns are employed in manufacturing the girders. The forms are so designed that the depth of the girders can be varied from 12 to 28 in. in 2-in. increments; the manufacturers also have developed forms for girders 12 in. wide and of 12 to 24 in. depth.

Reinforcing in the girders consists of five bars near the bottom and two at the top; two of the bottom bars are bent up near the end of the members. The longitudinal bars are tied together by stirrups, and, as shown by Fig. 4, pipes are welded to the reinforcing to provide holes in the finished member at the ends for tying the framework together. As illustrated, Fig. 2, lower left, the girders provide 4-in. wide ledges for supporting the beams.

Beams are all 12 in. wide and 12 in. deep. Only one form is required to manufacture the beams, and several depths may be constructed with the same form by bolting a steel angle to each side of the form. The form for the beams also has sides slightly sloped to permit easy removal of the finished product. Because the depth of the girders and floorbeams may be easily varied, different floor loads for the same or different column spacing can be accommodated by choosing the most satisfactory depth for the floor members. The manufacturers have developed tables to permit builders to choose the most satisfactory size of the various members for a given load, much as the builder might order

Fig. 3. Precast framework—columns, beams and girders were erected in three days. Floor slabs are channels 12 in. wide by 4 in. deep. They are designed for a load of 175 lb. per sq. ft. Column spacing is 15 by 20 ft., clearance available on first floor is 15 ft.

Fig. 2. Beams are lifted into place by crawler crane, and bolted to girders, which are tied down by threaded reinforcing rods extending from top of each column.



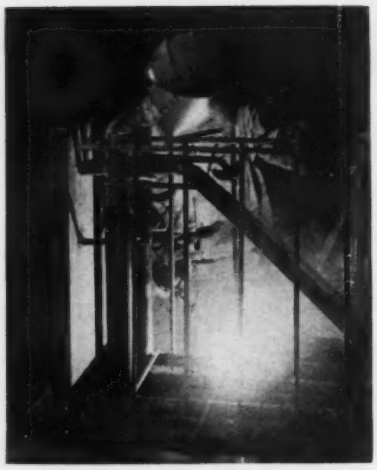


Fig. 4. Longitudinal girder reinforcing consists of five large bars near bottom and two smaller ones at top. Steel pipes welded to reinforcing provide holes for bolts embedded in the columns.

Fig. 5. Sturdy concrete forms that may be used many times are employed to manufacture girders of various lengths; sloping sides of form permit easy removal of member.

standard size structural steel members for any similar type of project.

The beams are reinforced similar to the girders. The reinforcing is added as a cage, complete with stirrups. Near the ends of the beam some of the bars are bent up and to both the top and bottom bars are welded short pipe sections to provide vertical holes in the finished member for the bolts that tie the framework together.

Floor slabs are channels

All roof and floor slabs are 12 in. wide channels of similar construction. They have a longitudinal bar at each corner. To accommodate different loads, the depth of these slabs may be varied from 3 to 4 in.

For the building under discussion, side walls are of concrete block, but precast concrete wall panels are used for the other precast concrete buildings under construction in the Pittsburgh area. One set of forms permits construction of wall panels 6 and 8 in. thick and generally 4 ft. high. The panels extend from column to column.

Separate coping, lintels and sills are not necessary. Neither are continuous foundations required under the wall panels, as they are supported at their ends on the column bases. The panels fit into grooves in the columns and thus are free to expand and contract. The horizontal joints, which are of tongue and groove construction, are filled with a colored elastic caulking compound, as are the vertical joints at the columns. Where windows are required they are made an even number of panels high, and the tongue of the supporting panel forms the sill and the groove in the first panel above a recess for the top of the window. Thus, no special lintels or sills are required for the windows.

A standard design also has been worked out for the doors whereby precast members for the lintel and jam can be used. The wall panels fit into the door posts much as into the columns. The wall panels and columns may be sprayed with cement paint or sheet plastics in many colors may be applied like wall paper.

One of the most interesting parts of the precast framework is the details at the joints. The various joints can best be described individually and that at the columns will first be explained.

When the floor girders are erected four vertical bolts projecting from the top of each column pass through holes in the girders; the holes are oversize at the top for a short depth to permit turning down the nuts flush. To provide good bearing and to support the girder at just the right height, a thin layer of grout is used.

Framework tied together

To tie the framework together in the transverse direction, the beams at each end are tied to the girders by $\frac{3}{4}$-in. dia. bolts. The bottom end of these bolts are cast into the girders and they extend through $1\frac{1}{4}$-in. dia. steel pipes embedded in the beams; the area between the bolts and pipes is filled with neat cement grout. Turning the nuts below the top surface of the beams is possible because the holes are oversize for a shallow depth. When the beams are erected, they are seated on a thin layer of grout, and after the bolts are tightened the space between the beam and the girder is filled with grout, making a very rigid joint. Furthermore, to provide continuity the reinforcing of the girders

Fig. 6 Finished columns are removed by overhead gantry crane 24 hr. after addition of concrete and placed in water for an equal period. By adding fillers between top and bottom forms larger columns are manufactured.

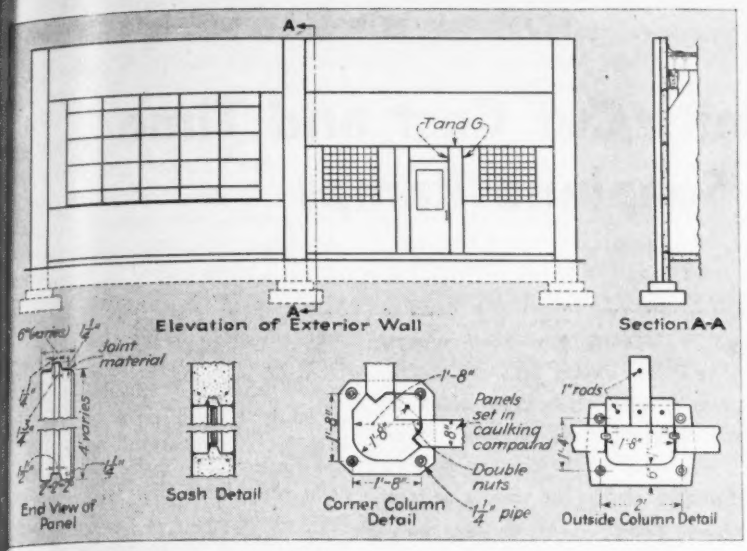


Fig. 7. Precast concrete wall panels of type above are being used on some of the precast concrete buildings under construction.

is butt-welded over the columns and the reinforcing of the beams is welded at their ends.

When the floor slabs had been laid in place on the beams and girders, a ½-in. dia. reinforcing rod was added in all transverse and longitudinal joints. With this steel in place, the remainder of the joints are filled with grout boomed in place. Although not used for the building illustrated, precast roof slabs similar to the floor slabs shown are employed in constructing other precast buildings in the Pittsburgh area. When casting the roof slabs, wallboard insulation may easily be added to the top surface of the panels. To support the roof panels, precast purlins are used.

The Cemenstone Co., First National Bank Bldg., Pittsburgh, Pa., owner of the patents and trademarks covering this construction and manufacturing system, manufactured and erected the precast members for the structure illustrated.

The company believes that by the elimination of field forms and the use of high-early-strength cement and by use of truck cranes for erection purposes, a low cost, speedy construction in any kind of weather may be possible. The licensing of ready-mixed concrete manufacturers is planned so that precast concrete units can be manufactured and widely distributed in any community in the country.

Britain Prepares for Extensive Postwar Building Program

Preparations for postwar rebuilding of bomb-damaged British cities have been carried one important step further by creation of the Ministry of Town and Country Plannings. This new government department will relieve the Ministries of Health and of Works and Planning of the duties connected with the physical reconstruction of British towns.

There is ample material for the new ministries to draw upon. Many of the towns that have suffered most have already prepared their own rebuilding plans. Some of these are very ambitious. For London a committee of the Royal Academy has worked out a plan of reconstruction, a somewhat controversial document attacked by some critics as being utopian in its insistence on many wide vistas and ample green spaces in the city.

Big housing demand after war

Interruption of war building activity will in any case greatly increase the demand for dwellings after the war. Before 1939 dwelling houses were being built at the rate of 350,000 a year. During three years of war only 135,000 houses have been constructed, and most of these had been started earlier. The 135,000 total has been offset by dwellings destroyed or irretrievably damaged by enemy action. Altogether, some 2,750,000 houses have suffered some damage, according to Minister of Health Ernest Brown.

Wherever possible, first-aid repairs have been carried out by private builders for town councils to make damaged houses fit for use. Labor and material, however, are so short that even this restricted program is taxing the building industry's capacity to the full. Recently the Ministry of Works and Planning has introduced a new system for the distribution of building work. A central register has been set up of all building contractors employing more than 100 workers in July, 1941; they are invited to tender for contracts of over $100,000, but are not given contracts exceeding 60 percent of their turnover in the years 1939–1941. Regional registers have been established for distribution of contracts of $100,000 and under.

Small firms to get work

Provision has been made for compulsory sub-contracting and for grouping of smaller firms for direct government contracting, as well as for consultation before preparation of tender lists. All these measures, as well as the restrictions on the total construction which individual contractors may carry out, serve the purpose of preventing the small builder from being crushed by the bigger firm.

Though these measures apply mostly to other building work than dwellings, attention to the needs of small local builders is considered necessary to enable them to make a start with rebuilding shortly after the war.

A housing advisory committee is now working out a program for new construction for the first ten or twenty years after the war, in order to get a good start. Between the two World Wars, in the twenty years from 1919 to 1939, no less than 4,000,000 houses were built in Britain. A building boom of similar proportions may well occur after this war. A limited start is to be made inside the nucleus of building labor available in order to provide training facilities for youths.

Precast Units Cut Cost and Time on Seaplane Ramps

***Contents in Brief**—Elimination of the time and cost involved in building cofferdams is an outstanding advantage of recently developed precast concrete designs for seaplane ramps. The latest design involves precast beams that fit over the piles and have slots on either side down which the precast deck labs are slid. No dowels or fastenings are required. In an earlier design, large square "cap slabs", supported at the corners on piles, were used instead of beams to support the deck slabs. The various units of this design were tied together with dowels and grout.*

ON THE OCCASION of the recent award of the Army-Navy "E" to the Austin Co., engineers and contractors of Cleveland, for work at naval establishments in the Pacific Northwest, covering buildings, docks, prestressed concrete tanks (*ENR* Jan. 28, 1942, p. 135) and other air station and supply depot structures, mention was made of an unusually efficient design that had been developed for seaplane ramps for locations subject to wide tidal ranges. The design referred to involves the use of precast beams and slabs that can quickly be installed on previously driven piles, without recourse to the costly and time-consuming operations incident to constructing ramps inside pumped-out cofferdams. The beams, set lengthwise of the ramp, are H shaped, and thus provide slotted keyways on either side to support the slabs, which are slid down these keyways from shore to form the deck. The beams are equipped with ingenious, integrally-cast boxes, spaced about 15 ft. apart, that fit over the tops of pairs of supporting piles. No bolts, dowels or fastenings of any kind are necessary, the only underwater work required being the pouring of small quantities of grout to give a tight fit between the pile tops and the boxes on the beams. Erection equipment is limited to a small floating crane for setting the beams.

These ramps, eight of which have been built so far, are the outgrowth of studies and developmental work for the Bureau of Yards and Docks carried out by the Austin organization over an extended period under the direction of W. R. Engstrom, vice president and general projects manager. Of these eight, six follow exactly the design mentioned above, while two utilize concrete-surfaced laminated timber deck units in place of the all-concrete slabs, an expedient used to save reinforcing steel.

A ninth ramp, designed for an aircraft plant on a protected waterway with slight tidal variations, involves a quite different, but also interesting design in which square "cap slabs", supported at the corners on piles, carry the deck slabs. Dowels fasten the cap slabs to the piles and the deck slabs to the caps, and grouting was required to bed the deck slabs evenly.

Precast beam-and-slab ramps

Details of the precast beam and slab ramps are shown in Fig. 1. Designed for 40,000 lb. per landing wheel spaced 15 ft. on centers, and to resist uplift and shock caused by waves and floating debris, the members are of husky section and well reinforced. The beams are of H-section, 37½ in. deep, with a 12 in. thick web. The top flange, 24 in. wide, is 8 in. deep, while a 13-in. depth is used for the bottom flange, which is made 36 in. wide to provide ample bearing surface for the support of the slabs. Main reinforcing consists of four 1-in. square bars in both top and bottom flanges. The beams are 30 ft. long, continuous over two spans.

Boxes, cast integral with the beams, engage the tops of the piles. Extending 18 in. below the bottom of the beams, these boxes have 8 in. thick walls and clear the piles by about the same amount to provide a space for grout, which is introduced under pressure through pipes cast in the beams. Experience indicated that it was important to make these pockets sufficiently large that lateral adjustment of the beams to exact alignment could readily be accomplished. The grout was held in place by wood forms hung by divers on iron pins cast into the walls of the boxes.

A basic requirement for the success of this type of ramp is to make the keyways in the beams absolutely true so that the slabs will slide down them easily. Careful forming is, therefore, demanded. At first, greased steel angles were used, both in the beam keyways and on the slab edges, but these were later abandoned and entire reliance placed on accurate forming and careful alignment during installation. Because of the grades of the ramps (7½ percent in some cases, 10 percent in others) very little force had to be applied to slide the slabs.

Based on considerations of wheel load spacing, pile loadings and weight, it was decided to cast the slabs 15 ft. square. Slab thickness was made 10 in., increased at the edges by turned-down flanges, reinforced as beams. The side flanges are 24 in. deep, shaped to fit into the keyways of the carrying beams, while the end flanges, used for stiffening only, are 20 in. deep. Each slab is pierced by breather holes and also by handling holes at the four corners.

Laminated timber deck units

Subsequent to our entry into the war, the Navy requested that as much reinforcing steel as possible be eliminated from the design. It did not appear practicable to change the precast beams, but it was decided that laminated wood slabs could be substituted for the concrete slabs. However, in order to provide a non-slip surface for the safety of the beaching crews, it was necessary to cover the

minated wood with a thin concrete at. Bonding of the concrete to the ood was accomplished by making ternate laminations 2 in. higher an the intervening ones and by ing projecting spikes to secure ad- tional resistance to the horizontal ear. This composite construction similar to that which has been used a number of bridge decks.

One problem to be solved was that expansion of the timber on immer- on in the water; should such ex- nsion occur, the concrete surface ould crack and tend to spall off. In- estigations of the absorption of ater by creosoted timber indicated at maximum swelling of the timber ould not be reached fast enough to eet the construction schedule, but at if an electrolytic copper treat- ent of recent development were used, satisfactory results were possible. This treatment was adopted and, after the mat had been built up and immersed sufficiently to obtain maximum absorption, the concrete surface was applied. This type of slab gave satisfactory results and offered no particular problems in construction. On the other hand, while it did save reinforcing steel, it did not show a saving in cost over the reinforced precast concrete slab.

Beam-and-slab ramp construction

Of the eight precast beam-and-slab type ramps, five were 50 ft. wide and three were 100 ft. wide. Two were on a 10 percent grade and six on a 7½ percent grade. Creosoted timber piling was used on all except one, where the presence of a rocky bottom made steel piles necessary. After driving, three steel piles were encased with removable steel forms, the water pumped out and concrete poured to the elevation of the pile box on the beams. This concrete served two purposes—to protect the pile and to make a form for grouting the beam box. After the steel piles were cut off and seat angles welded to the tops, the remainder of the work was carried out as on the timber pile ramps.

In all cases, dredging was carried down to at least 4 ft. below the ramp deck so as to allow room to install the beam boxes and to permit the divers to work most efficiently on the pile cutoffs. All piles were driven by means of a floating driver equipped with a steam hammer and a 4-in. water jet. The position of the piles, which necessarily had to be accurate, was controlled by lining and measur-

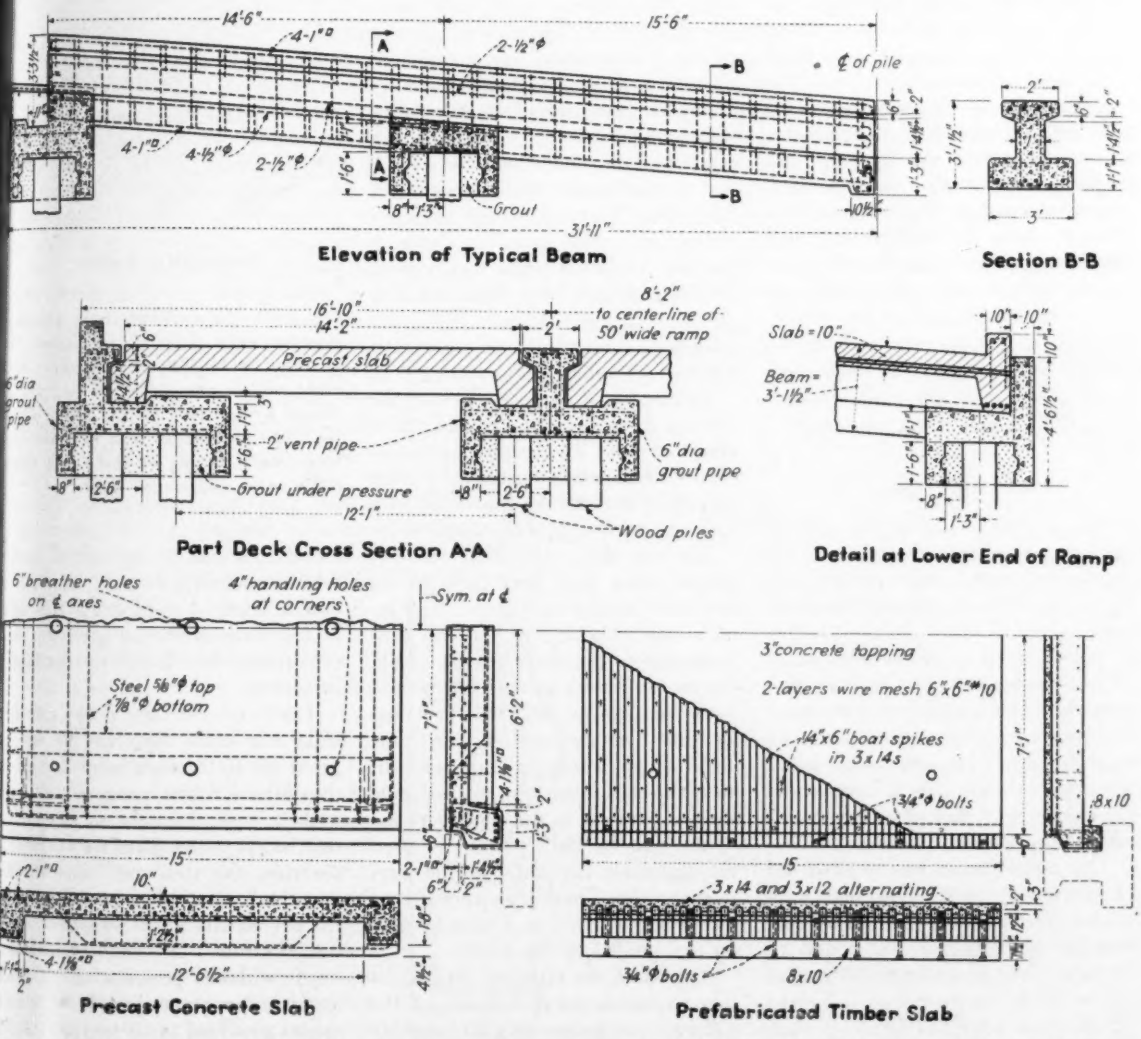


Fig. 1. Structural details of precast beam-and-slab type seaplane ramp. The H-shaped beams support the slabs between their flanges. Only underwater work required is the grouting of the beams to the piles.

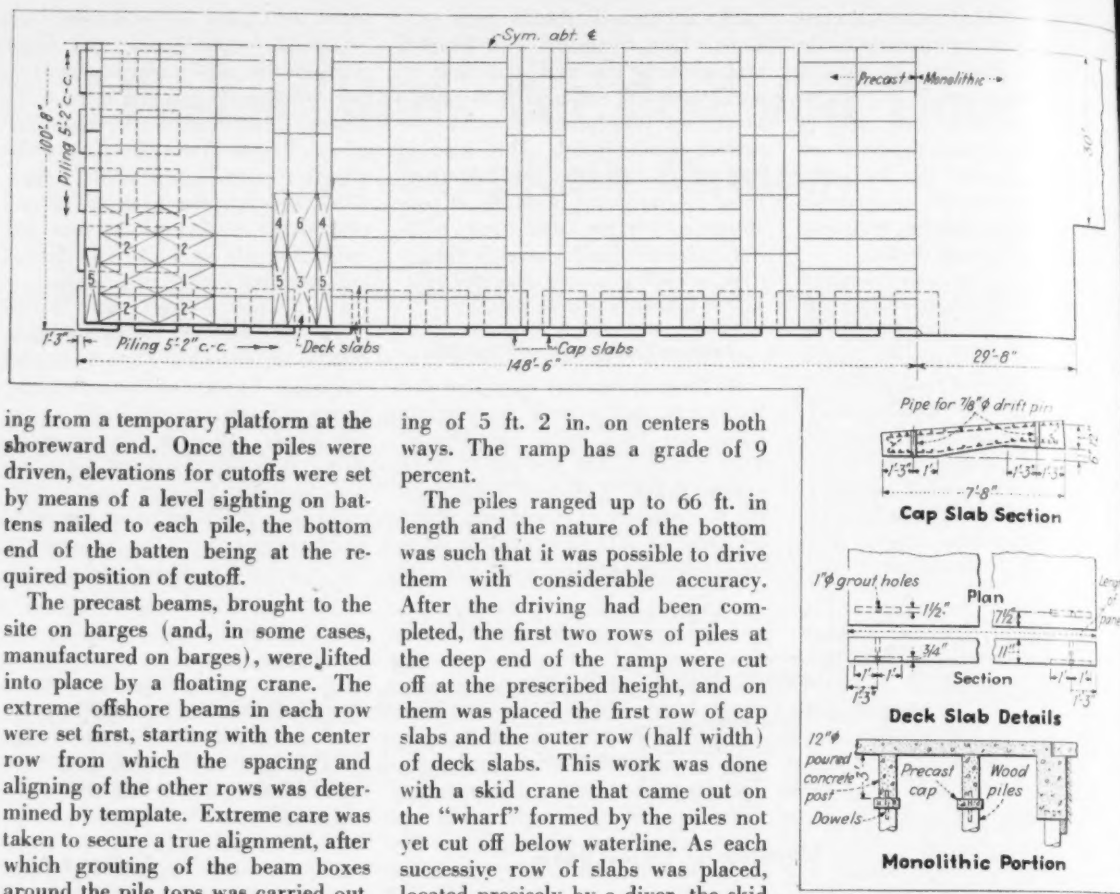


Fig. 2. In the cap-slab type of ramp, precast units 7 ft. 8 in. square are doweled to the piles and support deck slabs which are made in six sizes as shown by numbers on the above drawing. The transverse slab runs serve as ties. Note details of slabs and monolithic shore section at right.

ing from a temporary platform at the shoreward end. Once the piles were driven, elevations for cutoffs were set by means of a level sighting on battens nailed to each pile, the bottom end of the batten being at the required position of cutoff.

The precast beams, brought to the site on barges (and, in some cases, manufactured on barges), were lifted into place by a floating crane. The extreme offshore beams in each row were set first, starting with the center row from which the spacing and aligning of the other rows was determined by template. Extreme care was taken to secure a true alignment, after which grouting of the beam boxes around the pile tops was carried out. All of the beams were set before slab installation began. As stated, the slabs were entered in the beam slots at the shore end and slid forward, by power winch, one or two at a time.

Cap slab ramps

As previously stated, the precast beam-and-slab type ramp was developed subsequent to the installation of a precast ramp of quite different design, using cap slabs instead of beams as the carrying elements. This ramp 100 ft. wide and 178 ft. long was constructed without the need for floating equipment, other than a diver's scow, by means of a scheme for using the piles, prior to cutoff, as supports for the derricks that placed the slabs under the guidance of divers.

The ramp design was worked out to provide for two 33-ton loads supported 12 ft. apart. The most economical combination was found to be deck slabs of about 5x10-ft. size, 11 in. thick, supported on cap slabs 12 in. thick which, in turn, are each carried by four timber piles. All piling was driven with a uniform spacing of 5 ft. 2 in. on centers both ways. The ramp has a grade of 9 percent.

The piles ranged up to 66 ft. in length and the nature of the bottom was such that it was possible to drive them with considerable accuracy. After the driving had been completed, the first two rows of piles at the deep end of the ramp were cut off at the prescribed height, and on them was placed the first row of cap slabs and the outer row (half width) of deck slabs. This work was done with a skid crane that came out on the "wharf" formed by the piles not yet cut off below waterline. As each successive row of slabs was placed, located precisely by a diver, the skid rig moved inshore, and additional piles were cut off. In this way the work progressed shoreward.

The first run of deck slabs at the outer end was aligned with the aid of plumb bobs. Thereafter successive runs were aligned by a gage from the preceding run. Every fourth or fifth run was re-checked with plumb bobs.

The cap slabs, of which 150 duplicate units were used, are 12 in. thick and square in shape, 7 ft. 8 in. on a side. The top of the cap slab conforms to the slope of the ramp. On the underside at the inshore and outshore edge, a shelf was provided so that the squared-off pile tops could fit anywhere on this shelf. In each cap-slab form four vertical pipe sleeves were set in the shelf portions of the slab for drift pins to be used for fastening the slabs to the supporting piles. These pins were driven by means of a rod in a pipe by men on top, guided by the diver.

A total of six types of deck slabs was required, partly because of the different sizes needed for making transverse runs and partly because of the difference in reinforcing requirements that had to be suited to the locations of supports. In all slabs a double layer of reinforcing was used to take care of the design loads and of stresses that would be developed in lifting.

The joint between deck and cap slabs was made tight by the use of grout put in through holes formed in the slabs for this purpose and connecting with channels on the underside of the slabs, likewise formed at the time the slab was cast. In this grouting operation, a pressure of 50 lb. per square inch was first tried, but was found to be too high. When tried without pressure other than gravity, the grout moved down into spaces provided for it in a very satisfactory way. Thenceforth only gravity pressure was used.

The cap slabs weighed 8,900 lb. each. The deck slabs had a maximum weight of 6,600 lb. It was found simpler to cast the deck slabs with the sloping upper surface in a horizontal position (top surface up) making provision for the slope in the forming. To speed up operations in the casting yard, the slabs were cured under tarpaulin covers with the aid of steam for three to four days and then were placed in stockpiles.

For the concrete that was cast in place on the inshore end of this ramp, a 10-in. flat slab was used, carried by a simple floor system of concrete columns supported on wood piles. The piles were cut off below low water level and each one was capped with a precast concrete block or plate 18 in. square provided with a central hole for a dowel. The dowel projected upward so that concrete later cast on top of the pile to form the column would imbed the dowel. The precast top served also as a support for the forms for the flat-slab floor system. Further inshore, behind a concrete bulkhead, an earth fill was made and the concrete slab was continued as a pavement of varying thickness.

It may be noted in conclusion that all of the beam-and-slab type ramps also had inshore sections built on land, the precast construction being used only for that portion under water. On some of the ramps the shore portions were cast-in-place structures while on others it consisted merely of pavement on fill held in place by timber bulkheads and riprap. Where the sloping ramps joined the level parking areas on shore the transition was accomplished by means of a vertical curve of 30 ft. radius to assure that the planes would clear with the beaching gear used.

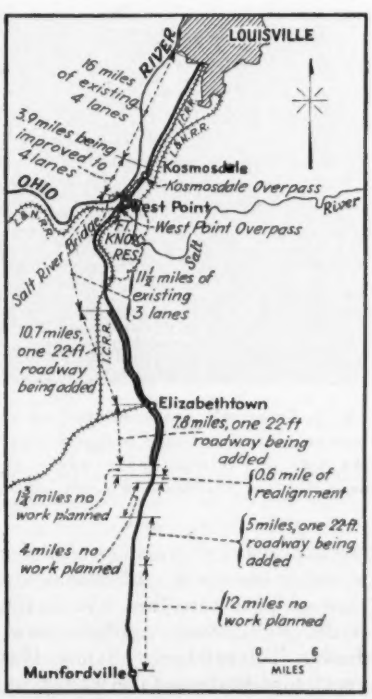
Kentucky Builds a Better Road To Serve Ft. Knox Area

Largest highway project now underway in Kentucky is the improvement of 28 miles of Route 31W between Louisville and Mundfordsville, 75 miles to the south. Major aim is to provide better highways in the vicinity of Fort Knox, through which the road passes. When the work in progress is complete, this route, which is known across Kentucky as the Dixie Highway, will provide between 34 and 35 miles of two-lane pavement, including the longest dual-lane road in the state. Traffic will be separated on much of the road, the alignment will be excellent, and only two railroad crossings will remain in the 75-mi. length.

As the accompanying map shows, the work now in progress is broken up into four sections. The first, which starts 11½ miles south of Louisville, is 3.9 miles long. It includes widening the road from two to four lanes and construction of two railroad grade separations and a bridge over Salt River. Two of the bridges are unusual and will be described in detail in a separate article.

The second section is improvement of 18.5 miles in the vicinity of Elizabethtown, including 10.7 miles north of that city. In this work a 22-ft. roadway is being added to provide two lanes of traffic each way. For the greater part of its length the new construction will follow a new and better alignment some distance from the old pavement and two roads will actually be available at this location.

A 0.6-mi. realignment job several miles south of Elizabethtown is the third section of Route 31W being improved, and the fourth is 5.0-mi. improvement starting four miles south of the project just mentioned. With the first work only a bad curve is eliminated, but in the latter a 22-ft. wide roadway is added to provide two lanes of traffic each way and two grade crossings will be eliminated. The traffic here will not be divided.



Work now in progress on Route 31W in Kentucky includes three bridges and 20 miles of 22-ft. pavement.

Two features of the new pavement are worthy of mention. One is that the new roads are of excellent alignment and in decided contrast to the sharp curves on the old roadways. The second feature is that no reinforcing will be used in the pavement, which will be of 8-in. uniform thickness for some work and for the remainder, 9-8-9-in. construction. Transverse contraction or weakened-plane joints are used on a 20-ft. spacing and ½-in. expansion joints on 120-ft. centers. No steel dowels are used in these joints. However, for the ⅛-in. wide weakened longitudinal joint ½-in. dia. dowel bars on 4-ft. centers are employed.

All work now in progress on Route 31W plus that already completed this year totals about $3,250,000. About 75 percent of the cost is being met by grants by the federal government.

For the Kentucky Department of Highways, T. H. Cutler is chief engineer, G. L. Logan, director of construction; H. R. Creal, bridge engineer; E. L. Lyons, district engineer at Elizabethtown and F. A. Shobe, district engineer at Louisville. Mack Galbreath, senior engineer, represents the Public Roads Administration.

Contractors on grading and paving include: L. G. Arnold, Inc., Eau Claire, Wis.; White Consolidated, Inc.; W. C. and A. Snyder & Nally and Mudd, Springfield, Ky.; Ellis, Kelley & Co. and Fount Crowe, Owensboro, Ky.; Tye & Wells, Carrolton, Ky.; F. J. Snyder, Elizabethtown, Ky.; F. C. Gornell & Sons, Russellville, Ky.; A. Wood Hardin, Louisville; and a combination of Fuller-Davies Co., Kentucky Road Oiling Co., F. M. D. Construction Co., all of Frankfort, Ky.

Laying Pipe Underwater With a Cradle

Photo: Norfolk, Va., Ledger Dispatch

Fig. 1. Section of the curved cradle used at Norfolk, Va. for assembling and launching a flexible-joint water main crossing the Elizabeth River.

***Contents in Brief**—Laying a 30-in. cast iron water main in a deep river channel at Norfolk, Va., was facilitated by the use of a curved, launching cradle. Sections of flexible-joint pipe were jointed together in the cradle, which was suspended between barges above water. When the barges were moved the pipe slid downward into a prepared trench, the cradle preventing greater deflection than that for which the flexible joints were designed.*

LONG EXPERIENCE with the difficulties and dangers encountered in submarine pipeline construction, led the city of Norfolk, Va. to specify the use of a cradle in laying a 30-in. cast iron main across the Elizabeth River. Not only did the city outline the method of installation, but also furnished to the contractor a detailed design of the launching cradle.

Based on a design originally developed in 1906 by Walter H. Taylor, III, long time director of public works for Norfolk, various modifications of the cradle have been used successfully on a number of river crossings. Details of the one used most recently to launch pipe in a 60-ft. depth of water, are shown in Fig. 3.

A schematic representation of the manner in which the curved cradle was used is given in Fig. 2. As outlined in the specifications, the cradle was suspended between two barges by means of cables carried by "A" frames, one on each barge. This manner of suspension provided a ready means for adjusting the elevation of the cradle, which at all times was kept at such a height that the submerged end would be nearly tangent to the channel bottom; the maximum angle of deviation was 10 deg.

Underwater pipe laying operations were begun at the end of a pier where the first pipe, flanged at the shore end and belled at the other end, was placed in the cradle. Additional sections of pipe were then laid in the cradle and joined together, using flexible ball-and-socket joints that were a modification of the Ward type. These joints were provided with a machined spherical surface on the spigot end, and a bell that would retain the lead in place within it when the spigot end moved. The outer surface of each bell also was machined for a distance of 3 in. from the face, and a $\frac{3}{4}$x3 in. steel tire shrunk thereon.

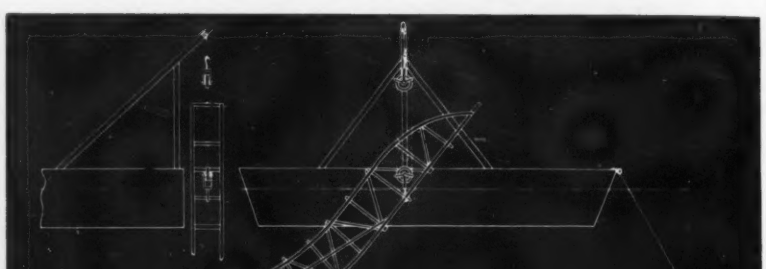


Fig. 2. Schematic representation of the manner in which the launching cradle was supported and used in laying pipe across a river channel 60 ft. in depth. All the pipe was jointed above water, and as the cradle was moved forward, the pipe slid into position in a previously excavated trench.

The flanged end was covered with a temporary bulkhead to make it watertight and a cable was attached

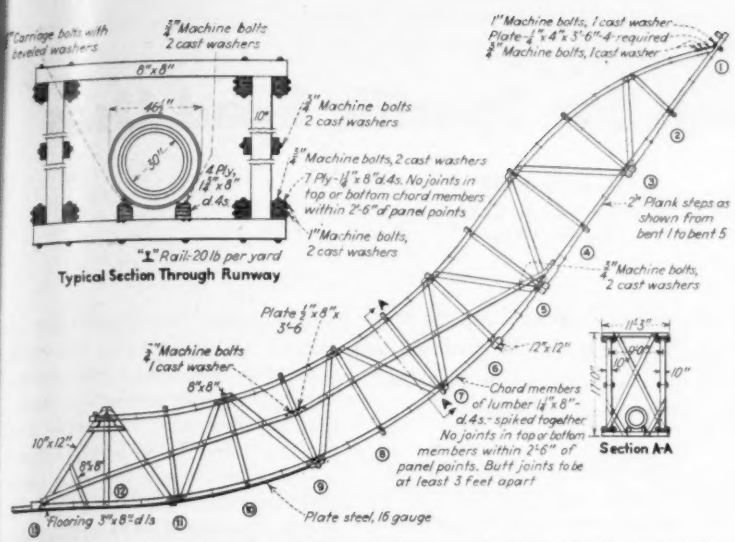


Fig. 3. Design and construction details of the curved chord, laminated timber launching cradle used for installation of pipe in deep water

to this section of the pipe. The string of pipe in the cradle then was lowered 12 ft. (the length of each pipe section) as each joint was completed. The cable was used to pull the completed line of pipe through the cradle and then ashore until the flange end was brought above the lowwater line.

Thereafter, as each additional joint was completed in the cradle, the barges and cradle were pulled forward 12 ft. at a time, using anchors ahead and other anchors to the rear to prevent greater movement than desired. Additional anchors were used both up and downstream to keep the center line of the cradle above the center line of the trench.

The cradle consisted essentially of two curved chord, laminated timber trusses, between which was fastened a runway deck for assembling and launching the pipe.

As shown in Fig. 3 the chord members were made up of 1¼x8 in., D4S, yellow pine lumber spiked together; the diagonal members were solid timber. Assembled in this manner and then bolted together, the cradle was very strong, withstanding surges of the two barges under all conditions encountered.

Pipelaying experience

First use of the cradle method in Norfolk occurred in 1906 when a 12 in. pipe was laid across a waterway 2,000 ft. wide with a maximum depth of 24 ft., reports Mr. Taylor. Since then more than a dozen river crossings have been laid, in water up to 60 ft. deep, the longest crossing being more than 4,200 ft. wide.

Only in streams of a few hundred feet width has pipe been laid under water by launching from inclined ways on shore. In cases where the pipe has sufficient buoyancy to float, it is put together in 12 ft. lengths, the front end bulkheaded, and then pulled across stream; it is kept in position by tag lines until removal of bulkhead permits water to enter and the pipe to settle to bottom. If the pipe lacks sufficient buoyancy, then cross timbers are fastened to it to which empty steel drums are attached to support each joint. Across narrow streams with shallow depths, this method is an easy one to use. However, for wide and deep water the use of a launching cradle is recommended. After the trench has been dug, the pipe laying becomes a simple task of joining the pipe and managing the floating equipment.

In 1920 when the largest flexible joint pipe was laid, it was recognized that the development of small "hair line" cavities were inevitable in each lead-poured joint and several experiments were made to determine leakage. Because the New York City method of "pumping" additional lead into the cold joint to remedy the condition was considered too expensive, it was decided to insert one strand of packing in the joint before pouring the lead. The strand was a cotton cloth tube of about ½ in. dia. when expanded, filled with fine sawdust. When the joint was leaded and tested no leakage at all developed with pressures up to 200 lb. per sq.in. As a result this method has been used in Norfolk ever since.

In the recent program of pipeline extensions made by the city, there were four major water crossings: Elizabeth River, 1,680 ft. across a channel of 60 ft. depth and 1,050 ft. across mud flats; Nansemond River, 1,080 ft. of deepwater installation and 900 ft. across mud flats; and crossings of the Western Branch of the Elizabeth River and Bains Creek, two shorter but navigable streams, requiring submerged lines of 552 ft. and 336 ft., respectively.

A. W. Baldwin of Norfolk was the contractor for all four crossings. The total bid was $99,704 for the undertaking complete, the city furnishing all the pipe and fittings.

Supervising field operations for the Federal Works Agency, who supplied part of the funds, was Harry C. Cowl, construction engineer. All the work was carried on under the direction of Walter H. Taylor, III, director of public works. H. H. George, III, assistant engineer in charge of services for Norfolk, provided information on which this article was based.

Removing Manganese in Water Supplies

Recurrences of manganese trouble have been experienced in nine Illinois municipalities this year, with the characteristic complaints of brown spots appearing during the laundering of clothes. According to the official bulletin of the State Department of Public Health the trouble was quickly eliminated in the majority of cases by raising the pH to about 9.0. At three supplies the manganese content was lowered satisfactorily by changing the depth of draft so as to draw water from near the surface of the reservoir. At Carrier Mills, however, it was necessary to raise the pH to 9.4 and to keep a chlorine residual from 0.3 to 0.4 ppm. in the mixing basin. Chlorine, as an oxidizing agent, helped oxidize the manganese to its insoluble form with the high pH, causing precipitation of the manganese during settlement. The bulletin warns that after manganese troubles have been corrected, the system and storage structures should be cleared of water high in manganese by thorough flushing.

Evaluating Soils for Specific Road Uses

D. L. Lacey
Senior Engineer, State Highway Commission of Kansas
Topeka, Kansas

***Contents in Brief**—Methods developed in Kansas for determining the relative value of each principal type of soil occurring on a highway construction project for use in the several parts of the highway structure is described. Charts used in the method are illustrated and their use is outlined.*

GROWING RECOGNITION among engineers of the value of the proper selection and method of placing soils as a means for increasing the effective life and decreasing the cost of maintaining highway surfaces has developed the need for a method of soil evaluation that will determine the suitability of each soil for use in constructing each separate portion of the road structure. Such a method was developed in Kansas in order to derive the most benefit from the information obtained during a preliminary soil survey and from laboratory tests conducted on soils sampled during the survey.

Soil studies begun early

Information pertaining to the extent and characteristics of soils that occur on proposed highway locations in Kansas is obtained during the preliminary planning survey by a soils engineer who is a member of each survey party. The soil survey is begun as soon as the centerline of the location has been established and the stationing is completed. Test holes are drilled to an elevation below the estimated ditch lines at sufficient intervals to locate the extent of the various soils that will be encountered during excavation, and a sample representing each type of soil on the project is obtained and submitted to the soils laboratory for test. The density and moisture content of the various soils in their undisturbed state are determined to furnish information for estimating "cut to fill" shrinkage during construction. Proposed borrow pits containing soil suitable for use on various portions of the road structure are located and sampled.

Upon completion of laboratory tests conducted on the soil samples, a soils profile is prepared that shows the location, with respect to the present ground line and tentative grade line, of each type of soil on the project. Based upon the results of laboratory tests and climatic conditions that exist in the immediate locality, each soil is evaluated for the various portions of the roadway in which it may be used. A written report is prepared that describes the soils as they occur within the limits of the location covered by the survey. Included in the report are recommendations to the design engineer that specify the soils which should be used in special portions of the road structure, such as the subgrade, shoulders and faces of embankments. The written report, the soils profile, and tables showing the estimated "cut to fill" shinkage then are sent to the design engineer for his use while preparing plans on the project.

The plans specify the location of the soils that have been selected for use in constructing the various portions of the roadway, and specify the locations where they are to be used.

Soil performance

A considerable portion of the total road structure consists of soils and, as previously stated, the ease with which it can be maintained depends to a large extent upon the type of soils of which it is constructed and the methods by which they are placed. Considerable effort is spent to select and place the soils where they perform to the best advantage so that it has become necessary to develop a method of evaluating each soil that occurs on a project for use in constructing each specific portion of the road structure.

The method developed takes into account all of the major factors that determine in which portion of a road structure a given soil will perform to the best advantage, or whether it will perform properly at any location in the structure. Since the most important factor is the characteristics of the soil as determined by laboratory tests, the test results are given primary consideration, while the average annual rainfall for the area in which the soils are to be used is given secondary consideration.

The soil classification system developed by the Public Roads Administration is intended to indicate the general characteristics of a soil. It does not, however, evaluate a soil for any specific use under any given condition of service. Some of the tests such as shrinkage, centrifuge moisture, etc., that are required to classify a soil by the PRA method are not conducted as a routine procedure in the soils laboratory of Kansas at the present time, while standard compaction tests and tests to determine the volume change characteristics of soils are conducted. The characteristics of a soil as revealed by these latter tests have been found to be valuable in predicting the performance of a soil in the road structure.

Tests for evalution purposes

Tests are conducted in the laboratory to determine the maximum compaction, optimum moisture, volume change, lower liquid limit, lower plastic limit, specific gravity and gradation of each representative soil sample submitted for test.

If the proposed surface type is to be a rigid pavement, swell tests are conducted on soils that will, during construction, be placed in the upper portion of the roadway where they will later act as subgrade to support the surface. The method of conducting this swell test in the laboratory has been described in *Proceedings*,

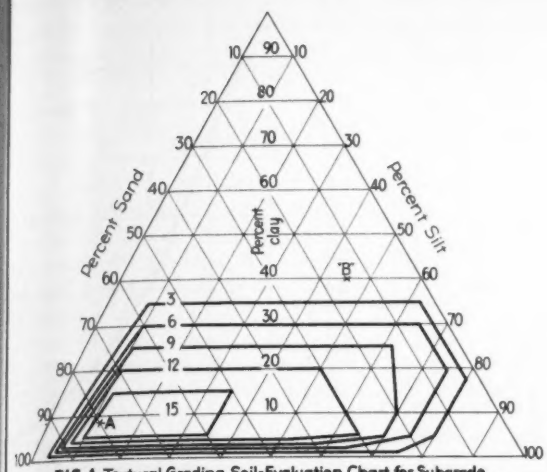


FIG. 1. Textural Grading Soil-Evaluation Chart for Subgrade for a Rigid Surface

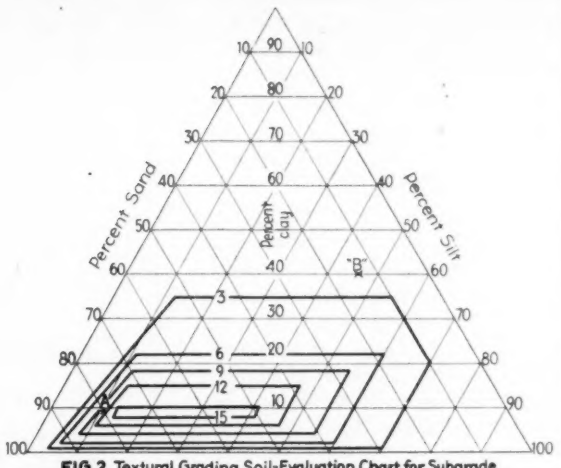


FIG. 2. Textural Grading Soil-Evaluation Chart for Subgrade for a Flexible Surface

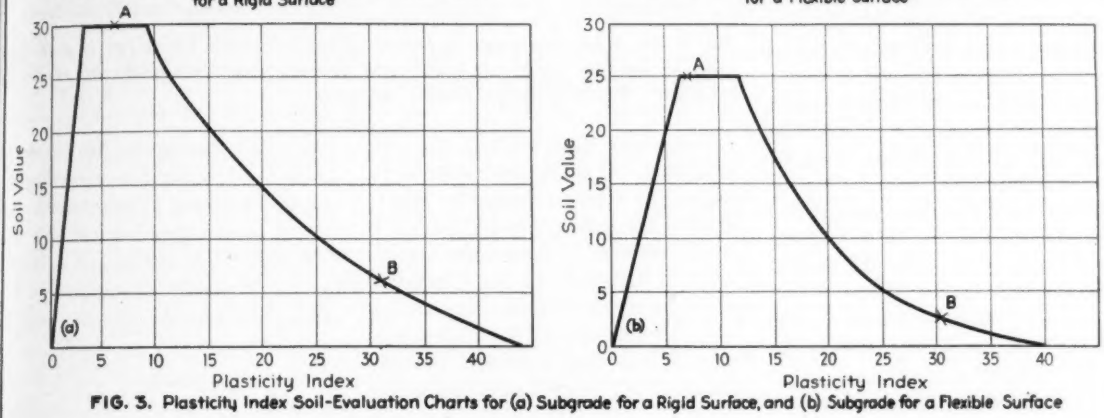


FIG. 3. Plasticity Index Soil-Evaluation Charts for (a) Subgrade for a Rigid Surface, and (b) Subgrade for a Flexible Surface

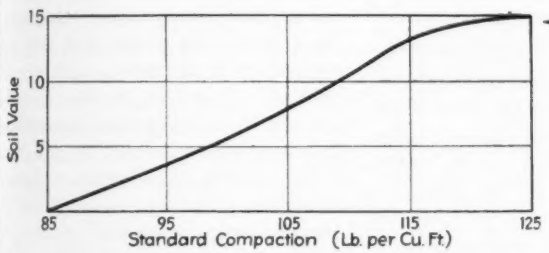
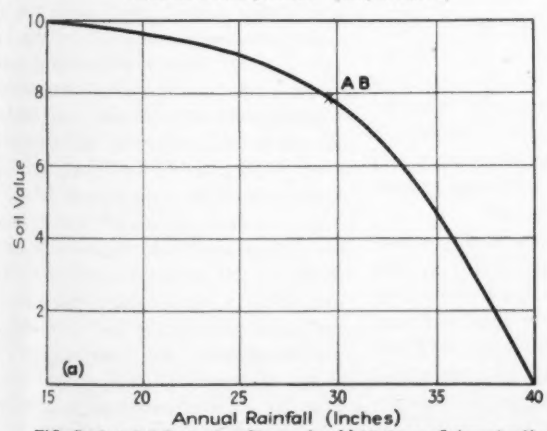


FIG. 4. Standard Compaction Soil-Evaluation Chart for Both Rigid and Flexible Pavements



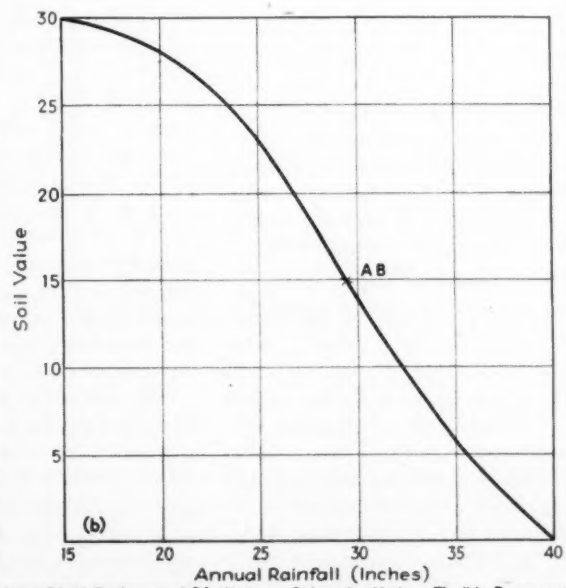


FIG. 5. Rainfall Evaluation Charts for (a) Highway Subgrades Having a Rigid Surface, and (b) Highway Subgrades Under a Flexible Pavement

The Highway Research Board (1936), and is at present being further developed for study by the American Society for Testing Materials.

The shrinkage test is conducted on soils that will be used as subgrade for flexible surfaces. As developed and used by the Kansas Highway Soils Laboratory, it is conducted by determining the loss in volume of a specimen of soil that was molded during the standard compaction test, and then oven dried at 110 deg. C. for a period of 40 hr. This loss in volume divided by the original volume of the specimen multiplied by 100 is designated as the shrinkage of the soil in percent. Since the moisture content at which the soil was molded is an important factor in this test, specimens that were prepared at three moisture contents are tested, and a curve plotted on coordinate paper using the initial moisture content as the abscissa and the percent shrinkage as the ordinate. By interpolating on this curve, the shrinkage of the soil when compacted at three percent above its optimum moisture content is determined.

In regions where the yearly rainfall is fairly well distributed, the shrinkage characteristics of a soil are not so important, but in Kansas where the rainfall is somewhat seasonal with intervening long periods of dry weather and hot winds, large shrinkage cracks develop in the more plastic soils as they dry. Cracks of this nature occur in the subgrade beneath both sand-gravel and flexible surfaces and extend through the surface leaving an appreciable opening for moisture to enter the subgrade during the next rain. Such cracks have developed through as much as twelve inches of base course and through the wearing surface, during recent dry years.

Method of evaluation

The present method of specific-use evaluation described herein determines the suitability of each soil when placed in each of the various parts of the roadway structure. The general uses or portions of a roadway in which soils may be used are: (1) foundations for embankments, (2) embankments (3) subgrades, which may be divided into subgrade for a rigid type of surface, subgrade for a flexible type of surface, and subgrade for a light type of surface, (4) shoulders, (5) ditch and embankment slopes, (6) binder material for aggregate-binder base construction, (7) admixture type of base construction. It is obvious that no one particular soil type will be entirely suitable for constructing each of the above portions of the road structure. For example, a well graded sandy-loam soil having no volume change with changes in moisture content and a standard compaction value of 120 lb. per cu.ft. has been found to perform satisfactorily as a subgrade material, but if it is placed to form the slopes of high embankments that are subject to the action of running water collected by the road surface it will erode rapidly and cause considerable fill loss and consequent maintenance expense. Similarly, highly plastic clays, if properly compacted, are very resistant to erosion, but do not serve satisfactorily as subgrade material for any type of surface. Therefore, a system based on past experience and soil knowledge was developed to take these factors into account.

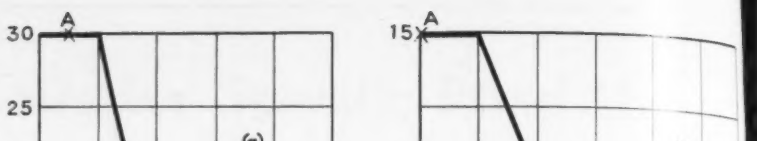


Fig. 6. Chart for evaluation of volume changes in soils. Chart (a) is used when studying soils for subgrades under rigid pavements, and chart (b) for studies of subgrades on roads having flexible surfaces.

The laboratory tests that are conducted in the Kansas laboratory that are considered most significant in this rating system are: (1) standard compaction, (2) plasticity index, (3) volume change, and (4) the hydrometer analysis and sieve analysis to determine the gradation of a soil. This method is used only to evaluate soil materials (passing the No. 10 sieve) and is not designed for evaluating materials containing a considerable portion of coarse aggregate, as this type of material is not commonly encountered in highway construction in this state. However, the system could be very well adapted to conditions in which coarse aggregate existed with the soils. The presence of the larger aggregate adds stability to a soil and reduces its volume change characteristics to such an extent that any one method of evaluation is not applicable to both a fine grained material and one containing considerable aggregate retained on the No. 10 sieve.

For each portion of the roadway structure, arbitrary values (derived from past experience and present soil knowledge) have been assigned to each laboratory test, and to the annual rainfall that occurs within the state, so that when they are added together the sum of the values for an *ideal* soil under the most nearly *ideal* conditions of local rainfall that occur within the state, will be 100. Since the average rainfall within Kansas varies from less than 15 in. annually in the west to more than 40 in. annually in the eastern portion of the state, this factor is of considerable importance in determining the value of a soil for any specific purpose in a given locality. As the test results and rainfall conditions for a given soil vary from the ideal values,

smaller values are assigned until the normal range of soils within the state have been covered.

To facilitate this operation, charts have been prepared that contain curves from which the value of a soil may be obtained. By entering the proper charts with the laboratory test constants and rainfall conditions for any particular soil, and adding the soil values so obtained, a total soil evaluation may be determined. Charts to be used in evaluating a soil for subgrade service beneath a rigid surface and beneath a flexible surface are shown in Figs. 1 to 6 inclusive. Other charts have been prepared that evaluate soils for use on other portions of the road structure.

To illustrate the method of using these charts, two soils having the following test constants will be evaluated for a given use:

Sample No.	Plastic index	Standard compaction (PCF)	Percent swell	Percent shrinkage	Percent sand	Percent clay
103	7	124	1	0	80	9
104	31	94	7	21	14	40

The average annual rainfall for the area in which these samples are to be used is 29 in.

These soils may now be evaluated for use as subgrade for either a rigid surface or a flexible surface, or other usage. To determine the value of Sample 103 for subgrade for a rigid surface, locate point A on Fig. 1 from the percentage of sand and clay in the sample. Since point *A* lies within the area designated as 15 this value is used as one factor to determine the total evaluation of the sample. Then locate point *A* on Fig. 3a to determine the value for the plasticity index of the soil, which gives a value of 30. On Fig. 4, a standard compaction value of 124 lb. per cu.ft. gives a value of 15. Similarly, point A on Fig. 5a, the rainfall chart, indicates a value of 8 for an area having an annual rainfall of 29 in. On Fig. 6a the swell-test chart. one percent swell indicates a value of 30. To find the total valuation of Sample 103, each of the individual values previously determined from the charts are added together, which gives a total value of 98, indicating an excellent soil for this use. Had the average annual rainfall been lower, the soil would have had a total rating of 100. Sample 104 may also be evaluated for subgrade for a rigid surface by locating point *B* on each chart as follows:

Gradation value	1
Plasticity-index value	7
Standard compaction value	3
Rainfall value	8
Swell-test value	3
	22

The total of 22 indicates a very poor soil for this type of construction.

These soils may also be evaluated for use as subgrade for a flexible surface as follows:

	Sample 103	Sample 104
Gradation	11	2
Plastic index	25	3
Standard compaction	15	3
Rainfall	15	15
Shrinkage	15	2
	81	25

As previously stated, other charts have been prepared which evaluate soils for use as subgrade for a sand-gravel or other light type of surface and also for constructing other portions of the roadway structure such as embankments, shoulders, and shoulder slopes. On these charts the value assigned to a particular laboratory test is usually different from those assigned to the same tests when preparing charts for subgrade construction for surfaces having an appreciable thickness. For example the gradation and plasticity index of a soil are the most important factors in determining the ability of a soil to resist erosion by water, while the standard compaction value of a soil is an important factor to consider when selecting a soil for embankment construction.

The following rating has been established in Kansas for the various soil values determined by the method described above:

90 to 100	Excellent
80 to 90	Good
60 to 80	Fair
40 to 60	Poor
under 40	Unsatisfactory

The values assigned to the various laboratory tests and climatic factors that are shown on the attached charts are entirely arbitrary and were designed to be applicable to conditions within the state of Kansas. However, similar charts may be prepared with proper values assigned to fit other conditions of highway construction and service.

Effective War Planning By State Agencies

Groundwork laid during recent years by state planning agencies proved the basis for some of the most effective war planning in the nation during the last year, the American Society of Planning Officials reports. State planning agencies also developed in 1942, or are working out methods, for adapting wartime facilities to post-war civilian needs, the society said.

Evidence of the work state agencies have done and are doing appears in plans developed to evacuate civilians from vulnerable urban areas, transport workers to and from war plants, and house workers adequately.

Planning activities of a score of states in 1942 illustrate the role that state planning agencies are playing in the war effort.

Michigan's state planning commission, for example, gave major assistance to the agencies developing the Willow Run war plant, while the Virginia planning board assisted in solving many problems connected with development of the Hampton Roads area, and aided city and county planning agencies in the state to develop post-war programs.

New Hampshire's state planning and development commission assisted the federal government in developing army and navy projects and is studying methods of adapting these wartime facilities to post-war civilian needs; Massachusetts' state planning board has given extensive aid to war industries and to the state defense council in solving acute transportation problems; California's planning board has made studies for the army on facilities and resources for war industries and, at request of the governor, has recommended an improved state defense council organization.

In New York, Massachusetts and other states, special commissions were set up last year to develop post-war public works programs; the New York committee was given an appropriation of $450,000 for preparation of plans and specifications.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Air Raid Signals Operated by Garage Compressors

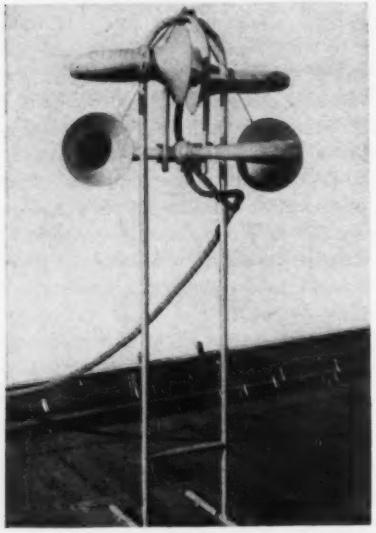
Air-raid signals designed and built by the city of Portland, Ore., have an important advantage in that they can be operated with existing compressor equipment found in all automobile service stations. As a result, it was possible to install the signals at strategic points around the city and utilize equipment that otherwise would be expensive and difficult to obtain at this time.

The signal, which was built by the city's bureau of fire, is of the horn and air-activated type. Seventy units have been installed (one for each square mile) and all are controlled from a central point.

Each of the seventy units is composed of four horns facing in different directions, and utilizes an air compressor for its operation; required air pressure is 50 lb. In a number of cases the signals have been installed on the roofs of service stations where air compressors already were available.

Says Public Works Commissioner William A. Bowes, who supplied this information: "On air raid signals we have had the same difficulty as all other cities. We found none adaptable to our community, and no manufacturer interested in developing one, so we made our own."

The design illustrated was developed by C. C. Ralph, alarm superintendent, Portland bureau of fire.



Air-raid signals at Portland, Ore., which operate with compressed air supplied by existing automobile service station equipment.

Camera Memorandum

To provide a 24-ft. head for testing leakage in wash-drain pipes in filter galleries at Chicago's new water treatment plant, a 25-gal. measuring tank was mounted as above. As a result, the desired pressure was provided with little trouble and the tank easily could be moved to new locations as desired.

Carl Regginback, resident construction engineer on the project, stands beside the tank.

Drawing an Angle with Scale and Compass

Whenever a protractor is required but not at hand to lay off angles, the method shown in the accompanying sketch has proven valuable. The exactness of the execution determines the accuracy of the angle sought and is most satisfactory for the purposes of the drawing board.

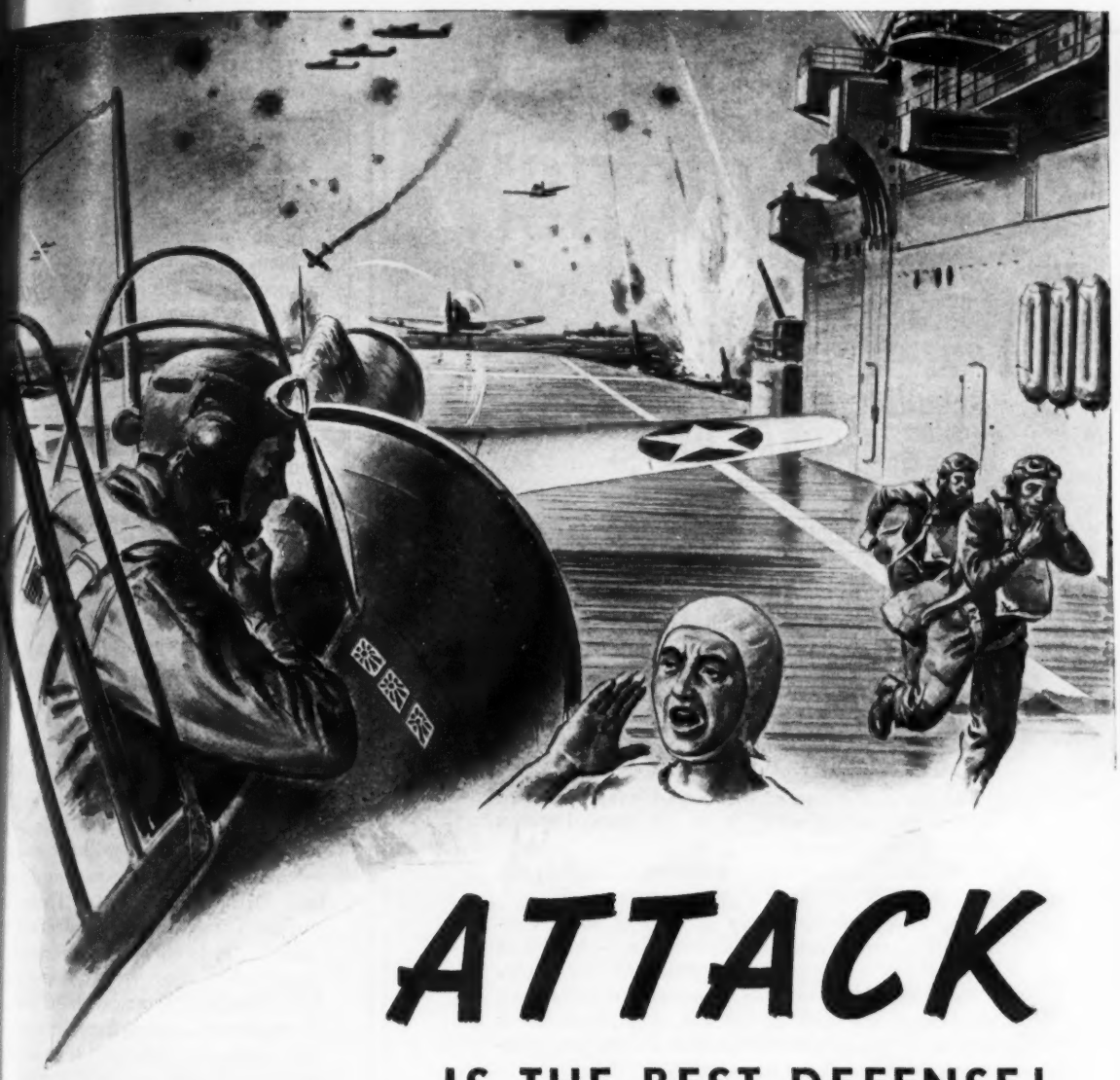
Any units of scale may be used, be it millimeters or sixteenth of an inch, whichever is at hand; a larger scale naturally will determine the angle more correctly and it will make up for unavoidable small deficiencies in the execution.

The diagram shows how to determine an angle of 60 deg. or 90 deg. Both can be checked with a drafting triangle. The inner circle is drawn with radius AB equal to one radian or 57.296 units, and the outer with radius $DG = DB = BC$ or $AB\sqrt{2}$. The figure 57.3 for a radian can be estimated on a scale and is a very close approximation to the actual value.

On the outer circle strike off around B the dimensions equal to the degrees required to locate E, for instance 60 mm. for a 60-deg. angle. Next draw a line ED through the smaller circle at F. Then Point F will be on 60 deg., the angle sought. In the same way if Point G is located on the chord BG = 90 mm. (not drawn), the line GD cuts the smaller circle at C, which locates the 90-deg. angle.

Any angle within 90 deg. or its complement can be constructed in this manner. Although the method is correct up to 120 deg., it is not advisable to so determine angles in the second quadrant, for beyond 120 deg. the results are erratic and finally impossible.—*A. F. Jobke, 1688 Pioneer Ave., Pittsburgh, Pa.*

Graphical method of laying off angles when a protractor is not available



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TRENDS IN THE NEWS

Asphalt group forms industry war council

In an effort to meet the mounting problem of supplying America's roofing needs, on both home and fighting fronts, the asphalt and tarred roofing industry, at a special meeting held in Chicago's Blackstone Hotel, November 5th, formed an Industry War Council, open to all producers of asphalt and tarred roofing in this country.

Energizing and directing the Council is a nine man committee under the chairmanship of P. C. Rowe of New York. Immediate objectives of the group are to provide a liaison with the WPB and other government agencies, and to enlist the pooled experience and facilities of the roofing industry in a furtherance of the nation's war program.

The Council plans to study exhaustively the industry's uses of labor, materials and transportation in the light of war needs. "The whole influence of war policies will be studied for their effect on the roofing industry," Mr. Rowe states. "These include: A possible concentration of the industry to effect a more economic use of labor, transportation and critical materials; the maximum use of all machinery and spare parts available within the industry; the possible shortage of raw materials, not as yet scarce, which may bring about a future need of allocation; and the progressive shortage of transportation.

"In addition to providing necessary roofing for normally deteriorating civilian roofs, the industry is also readying itself for the emergency repair of bombed and shattered roofs resulting from enemy air attack on cities and towns in this country. According to air tactics authorities, Hitler may launch such attacks on our major war producing centers, as soon as our air power threatens to eclipse that of the Luftwaffe.

"If such attacks occur, it will be necessary to supply instantly vast quantities of emergency roofing material, labor and transportation," Mr. Rowe continues. "Asphalt-impregnated roll roofing makes one of the most perfect, most available emergency materials for covering shattered

windows and skylights. This same material, stretched over light wood frames, can make tent-like barracks in only a few hours. Asphalt mineral surfaced shingles and roofing and smooth roll roofing may also be needed in considerable amounts to patch bomb-shattered roofs.

"The industry obtained valuable experience in meeting emergency roof needs during the New England hurricane of 1939, which created an overnight need for vast quantities of roofing material.

"Our manufacturers met it by operating their plants 24 hours a day; by gathering every bit of stocked roofing from warehouses and dealers. Asphalt roofing trucks were among the first to break trail into many parts of New England. This minute-man response saved millions of dollars worth of property, in addition to its contribution to health and comfort."

Cooperating with Chairman Rowe are eight other leaders in the industry. They are: H. Abraham and W. B. Alexander of New York; F. E. McNally of Minneapolis; O. Cervenka and M. G. O'Reilly of Chicago; B. H. Roberts of East Walpole, Mass.; J. Brown and W. H. Lowe of Los Angeles.

• • •

Set up long range water improvement program

Uel Stephens, new water superintendent for the City of Fort Worth, Texas, last week announced a five-year improvement program looking toward general improvement of the city's pumping, treatment facilities and water conduits and supply lines.

He said that the engineering firm of Freese & Nichols of Fort Worth, had been employed as consulting engineers on the program. He said that it had been decided to purchase this year two 15,000,000 gpd centrifugal pumps, electrically driven, to supplement the city's present pumping capacity. Further improvements over the five year period envision the expenditure of about $200,000 a year, Mr. Stephens added.

John U. Shroyer, of Northumberland county, Pa., a dress manufacturer, has been named secretary of highways for Pennsylvania by Gov. Edward Martin. Mr. Shroyer succeeds I. Lamont Hughes, highway secretary for the past four years under Gov. Arthur H. James.

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Opacity achieved without thickness of lead deposit, and therefore less tendency to smudge tracings. The whites of your blueprints come sharp and clean. HI-DENSITY MICROTOMIC Leads draw a sharply defined line; no furry edged reproductions. And you gain this opaque, solid line without pressing into the paper. Corrections and erasures are easily made.

Here you have opportunity for improved drafting technique in which every man at the board must be vitally interested.

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TRY THE "CHISEL POINT" (Rectangular Lead) in your choice of 4B-2B HB-2H-4H-6H

20% more graphite at the point of wear

A SAMPLE PENCIL FREE

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37 Greenpoint Ave., Brooklyn, N.Y.

Please send me a_____degree MICROTOMIC "VAN DYKE" with HI-DENSITY_____Round, or_____Chisel Point Lead for test demonstration of the claims you make for it.

Name_____

Position_____

Business Address_____

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

HIGHWAY SURFACING, UTAH

OWNER: Utah State Road Commission, Salt Lake City; John S. Evans, Chairman.

PROJECT: Plant-mixed bituminous surfacing 3.091 miles State Highway on 21st South Street between Main Street and Redwood Road, Salt Lake City, Salt Lake County, Utah. Plant-mixed surfacing is 2½-in. thick, and of variable width.

CONDITIONS: Contractor to furnish all materials and complete work in 170 working days. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.25 to $1.35 per hour; semi-skilled, 90c; and common labor, 75c per hour.

BIDS: Four bids were received December 31, 1942, ranging from the contract low of $280,912 to $452,429. Engineer's estimate, $376,126.

LIST OF BIDDERS:

1. Gibbons & Reed, Salt Lake City, Utah (contract) ... $280,912
2. W. W. Clyde & Co., Springville, Utah ... 293,165
3. A. O. Thorn & Sons Constr. Co., Springville, Utah ... 381,815
4. Reynolds Ely Constr. Co., Springville, Utah ... 452,429

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Bituminous mat'l., 200-300 penet.	97,000 gal.	$0.10	$0.10	$0.12
2. Bituminous mat'l., Type RC-3	15,900 gal.	.13	.12	.14
3. Bituminous mat'l., Type MC-1	31,800 gal.	.13	.12	.14
4. Plant mixed bitum. surfacing	8,800 ton	3.00	2.25	2.75
5. Crushed rock or crushed gravel surface course	20,400 ton	.93	.92	1.25
6. Gravel or cr. rock base course	30,300 ton	.88	.90	1.25
7. Cover material	800 ton	2.75	3.00	4.00
8. Unclassified excavation	200,100 c. y.	.29	.25	.35
9. Overhaul, Class A	1,375,000 sta. y.	.01	.015	.02
10. Overhaul, Class B	497,300 yd. mi.	.10	.15	.20
11. Rolling	3,000 hr.	5.50	3.50	4.00
12. Watering	3,604 M gal.	1.40	1.50	2.00
13. Channel excavation	9,000 c. y.	.35	.35	.75
14. 15-in. concrete pipe	730 l. f.	2.15	2.25	3.00
15. 18-in. concrete pipe	186 l. f.	2.65	3.00	4.00
16. 30-in. concrete pipe	180 l. f.	4.75	5.25	6.00
17. 36-in. concrete pipe	772 l. f.	6.75	7.25	9.00
18. 48-in. concrete pipe	117 l. f.	9.50	10.00	12.00
19. Relay 12-in. corr. galv. metal pipe	76 l. f.	1.20	1.00	1.50
20. Relay 12-in. concrete pipe	106 l. f.	1.30	1.00	1.50
21. Relay 15-in. concrete pipe	34 l. f.	1.50	1.50	1.50
22. Relay 18-in. concrete pipe	101 l. f.	1.60	2.00	2.00
23. Excavation for structures	1,500 c. y.	1.40	1.50	5.00
24. Concrete, Class A	35 c. y.	45.00	35.00	42.00
25. Concrete, Class B	168 c. y.	40.00	30.00	40.00
26. Reinforcing steel	300 lb.	.10	.10	.10
27. Untreated timber (Native Red Pine)	16.6 Mbm.	110.00	100.00	200.00
28. Waterproofing	220 s. y.	1.75	1.00	1.00
29. Concrete curb, No. 1-C	2,650 l. f.	1.00	1.00	1.50
30. Conc. curb and gutter, No. 3-F	110 l. f.	1.60	1.50	1.50
31. Conc. curb and gutter, No. 3-H	3,550 l. f.	1.60	1.50	1.50
32. Conc. curb and gutter, No. 3-I	220 l. f.	1.60	2.00	1.50
33. Concrete sidewalk, 4-in. thick	1,300 s. y.	1.80	2.20	.60
34. Concrete sidewalk, 6-in. thick	80 s. y.	2.75	3.30	.90
35. Conc. driveway and driveway curb	640 l. f.	7.50	5.50	2.00
36. Removal of existing sidewalk	1,400 s. y.	.45	.30	.50
37. Reconstruct cleanout boxes, manholes and monuments	10 ea.	15.00	100.00	100.00
38. Move fence	14,200 l. f.	.10	.10	.10
39. Remove trees	253 ea.	15.00	25.00	10.00
40. Federal-Aid project markers	2 ea.	20.00	20.00	20.00

BRIDGE PIERS, TEXAS

OWNER: Texas State Highway Commission, Austin; D. C. Greer, State Highway Engineer.

PROJECT: Construction of two concrete caisson-type piers for main span of proposed Little River Bridge on State Highway 36 and U. S. Route 77 in Milan County, about one mile southeast of Cameron, Tex.

CONDITIONS: Contractor to furnish all material except reinforcing steel, and complete work in 110 working days. Rail and highway transportation facilities available. Wage rates are: skilled labor, $1.00 per hour; semi-skilled, 50c; and common, 40c.

BIDS: Twelve bids were received January 26, 1943, ranging from the contract low of $25,823 to $46,657.

LIST OF BIDDERS:

1. Southern Contracting Co., Austin, Tex. (contract) ... $25,823
2. Cage Bros. & L. A. Turner, Bishop, Tex ... 28,234
3. L. & L. Construction Co ... 28,585
4. Thomas & Ratliff, Rogers, Tex ... 31,023
5. M. E. Worrell, Austin, Tex ... 31,837
6. Austin Bridge Co., Dallas, Tex ... 33,033
7. Standard Paving Co., Fort Worth, Tex ... 34,813
8. Ernest Loyd, Fort Worth, Tex ... 37,233
9. Purvis & Bertram, Fort Worth, Tex ... 37,467
10. Wallace & Bowden, and Norman Larson, Dallas, Tex ... 38,921
11. Charles Cohen, Dallas, Tex ... 39,225
12. Ben Sira & Co., Dallas, Tex ... 46,657

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Unclassified structural excav	985 c. y.	$4.50	$5.50	$6.00
2. Class A concrete	553.4 c. y.	25.00	26.00	28.00
3. Class B concrete	155.52 c. y.	21.00	22.00	22.00
4. Class E concrete	142.06 c. y.	19.00	24.00	18.00
5. Place reinforcing steel	58,798 lb.	.02	.02	.02
6. Structural steel	2,760 lb.	.16	.16	.16

BRIDGE AND APPROACHES GEORGIA

OWNER: Georgia State Highway Department.

PROJECT: Reinforced concrete bridge over the Darien River with 0.258 miles of grading and approach fills on the Brunswick-Darien Road, McIntosh County, Ga. Bridge length is 1,452.5 feet; height, 76 feet from bottom of footings; and width 44-ft.

CONDITIONS: Contractor to furnish all materials and complete work in 240 working days. Rail, highway and water transportation facilities available. Wage rates specified are: skilled labor, 60c. per hour; semi-skilled 40c.; and common labor 30c.

BIDS: Four bids were received November 10, 1942, ranging from the contract low of $989,509 to $1,148,464.

LIST OF BIDDERS:

1. Scott Constr. Co., Thomasville, Ga. (contract) ... $989,509
2. Espy Paving Co., Savannah, Ga ... 1,051,649
3. C. Y. Thomason Co. and McMeekin Constr Co., Savannah, Ga. ... 1,086,882
4. Coffee Constr. Co., Eastman, Ga ... 1,148,464

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing and grubbing	Lump Sum	$1,200.00	$1,000.00	$1,250.00
2. Muck excavation (No. 1)	38,510 c. y.	1.00	1.00	1.00
3. Muck excavation (No. 2)	2,628 c. y.	2.00	1.50	1.00
4. Hydraulic embankment	61,640 c. y.	.60	1.00	.80
5. Embankment placed in 6-in. layers	10,484 c. y.	1.00	1.50	1.00
6. Provide detour bridge	1,300 l. f.	45.00	45.00	35.00
7. Sand asphalt road-mix, incl. 4 tons cutback asph	4 ton	25.00	9.00	12.00
8. Common and borrow excav. for detour	700 c. y.	1.00	1.00	1.00
9. Sprigging	2,500 s. y.	.05	.04	.15
10. Remove timber bridge	Lump Sum	500.00	200.00	1,000.00
11. Class A concrete (substr.)	3,350 c. y.	45.00	40.00	43.00
12. Class A conc. deposited in water	4,000 c. y.	50.00	45.00	40.00
13. Bar reinforcing steel	350,000 lb.	.06	.06	.07
14. Excavation (No. 1)	10,100 c. y.	15.00	15.00	20.00
15. Excavation (No. 2)	1,200 c. y.	20.00	15.00	20.00
16. Timber piling, untreated	570,000 l. f.	.80	1.25	1.75
17. Timber piling, treated (16-lb.)	4,600 l. f.	2.00	1.50	2.40
18. Channel excavation	10,000 c. y.	1.00	1.00	2.00
19. Treated bridge timber (16-lb.)	10.5 Mbm.	200.00	200.00	250.00
20. Clearing and grubbing	Lump Sum	1,200.00	500.00	1,300.00
21. Remove existing bridge	Lump Sum	10,000.00	20,000.00	8,000.00
22. Plain stone riprap	1,000 s. y.	2.50	2.50	3.50
23. Timber test piles	10 ea.	200.00	175.00	150.00
24. Concrete precast piles	1,500 l. f.	6.00	10.00	6.00
25. Concrete test piles	2 ea.	400.00	250.00	450.00
26. Class A conc., superstr., Bent 1 to pier 23 and pier 27 to bent 3	2,275 c. y.	40.00	42.00	45.00
27. Cl. A conc., superstr., pier 23 to pier 27	575 c. y.	40.00	42.00	50.00
28. Bar reinforcing steel	698,000 lb.	.06	.06	.07
29. Concrete handrail	2,905 l. f.	4.00	3.00	5.00
30. Painting struct. steel	Lump Sum	5,000.00	5,000.00	5,400.00
31. Remove detour bridge	Lump Sum	5,000.00	40,000.00	2,500.00

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THERE'S still plenty of cold weather ahead. For quicker, better work use 'Incor' 24-Hour Cement. 'Incor' concrete needs only one-day (in sub-freezing weather, 2-day) heat protection. Only half as many salamanders are required—and you save at least 50% on fuel and heating labor. Canvas requirements are also cut in half or less. And dependable 'Incor' high early strengths save 50% to 60% on forms, through faster re-use.

Save time, save money, save worry—use 'Incor',* the FIRST high early strength Portland cement, backed by over 15 years' outstanding performance in all kinds of work under hardest service the country over.

*Reg. U. S. Pat. Off.

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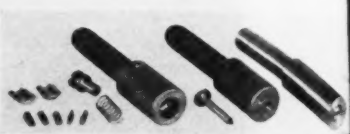
Fluorescent Unit

The Appleton explosion proof fluorescent unit, shown in the accompanying photograph, is said to comply with the requirements for Class I, Group D, and Class II, Group G hazardous locations. The construction completely eliminates the need for ceiling fixtures, fittings and accessories. A terminal block is provided to make line connections and all factory connections are made to the same block, thereby eliminating splices. The reflector is non-metallic, baked white enamel finish, and fixture is furnished with two 48 in. T-12 40 watt lamps. Another advantage claimed is easy accessibility to lamps, starters and ballast making replacement a simple operation.—*Appleton Electric Co., 1701-1729 Wellington Ave., Chicago, Ill.*

Steel Stamps

Designed expressly for marking the ends of shafts and other parts having a center hole. New Method Steel Stamps Inc. is now producing an improved steel type holder that may be used either with individual type or with logotypes made to specifications of the user. End marking is often desirable, since the end of a shaft or other part is frequently visible when the outside surface is enclosed in a housing. When furnished with knurled shank, the holder is used for hand stamping, and with a turned shank it may be mounted in a press. The holder is equipped with a floating locating pin backed up by a light spring to insure proper register of markings around the center.—*New Method Steel Stamps, Inc., 145 Joseph Campau St., Detroit, Mich.*

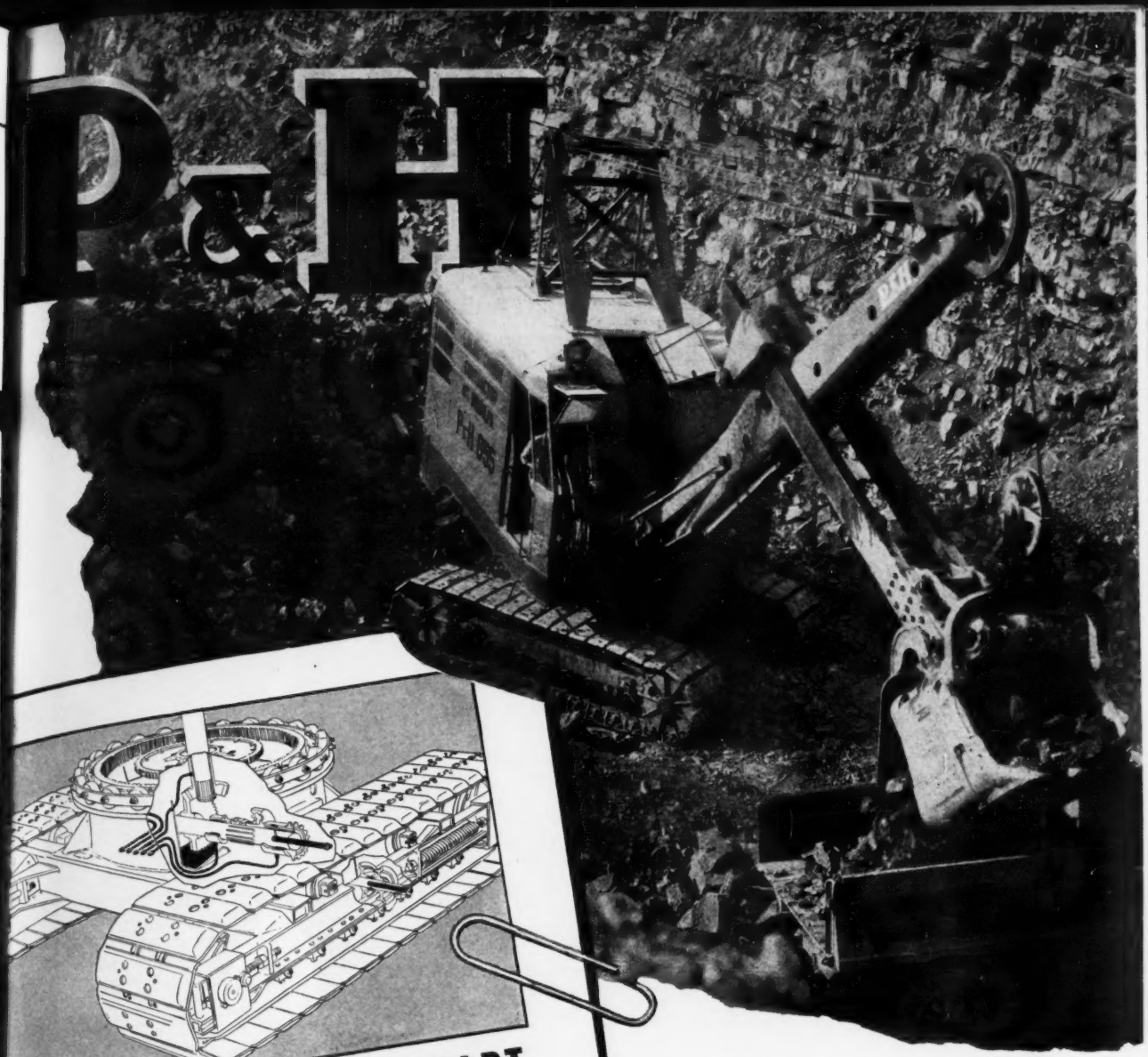


Turbine-Type Pumps

Designed primarily for aviation refueling systems, a new turbine type pump manufactured by the Deming Co. have proved equally successful for use in pumping gasoline and fuel oil from tankers; pumping quenching oil and other liquids, for use in fueling station for trucks, tanks, marine craft, as well as in refineries and other industries. Advantages of the pumps are said to include elimination of priming difficulties, low installation cost, minimum floor space requirements, high efficiency, low operating cost, and freedom from lubrication difficulties. Capacities of the new turbine-type pumps range up to 1000 gal. per min. against head pressures generally encountered in gasoline fueling systems. Higher capacity is available at slightly reduced pressure in case of increased demand. Pumps are self-venting and cannot become vapor locked, the manufacturer says.—*The Deming Co., Salem, Ohio.*

Hopper Attachment

To make possible a standard method of handling hopper-contained bulk materials in a wide variety of production operations, the Towmotor Co. has developed a hopper attachment that demonstrates flexibility essential to efficient performance on individual, specialized jobs through the use of standard lift truck models. Designed for use with standard fork equipment, the hopper is available in various sizes. To provide a firm carrying position and permit rapid tilting in dumping hopper loads, the attachment is carried directly on the fork support bar of the lift truck by means of a hook arrangement that is an integral part of the hopper. Said to be especially suitable for efficient, economical handling of small parts and bulk materials chuted from storage bins or discharged from production machines, the hoppers afford an extremely practical means of collecting materials at production or processing points and



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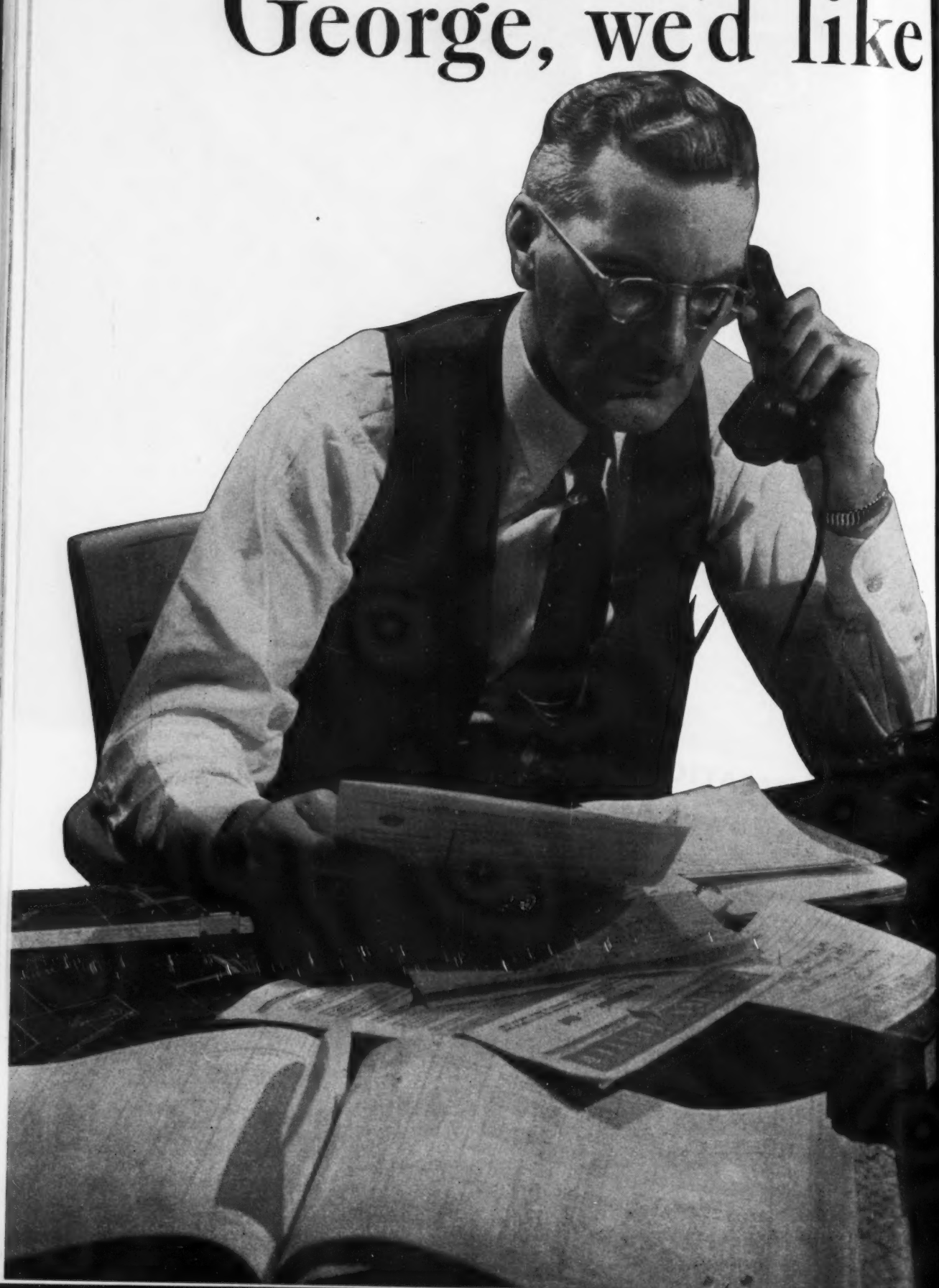
George*, we'd like t



e to shake your hand

YOU'RE such a matter-of-fact fellow, George, that maybe it never occurred to you that you've done anything out of the ordinary since that fateful Sunday when America found itself at war.

Sure—you've just done your job as you saw it. But listen, George. Planning and engineering our war effort—keeping the wheels turning and supplies and materials moving—figuring out the million minor details . . . that took brains of a special sort. The vast load of paper work that had to be done before a single machine could function, before a single bomber could lay its eggs, didn't just do itself. You did it.

When bad news came over the wires, you set your jaw and worked just that much harder. And when the news was good, you took it with a quiet smile and kept right on plugging away. No, George, not all the heroes in this war are making the headlines.

The late hours you spent at your desk when the others had left . . . the way you've planned and sweated to meet one emergency after another . . . the extra work you've taken on your patient shoulders when younger men were called away for more spectacular, more exciting duties, wasn't exactly a snap, either.

Maybe you don't wear a uniform, George, but remember this. You're on the all-important staff of the home-front army. If it weren't for you, and the thousands of Georges like you, our job of war production would be in an awful mess right now.

**Who is George?* *Surely you know dozens of Georges. He stands beside you on a crowded bus early in the morning. You've watched him coming wearily home from work long after the rest of the neighbors have finished supper. He may even be the fellow who makes those funny faces at you as you shave before your mirror in the morning. More power to you!*

CARNEGIE-ILLINOIS STEEL CORPORATION

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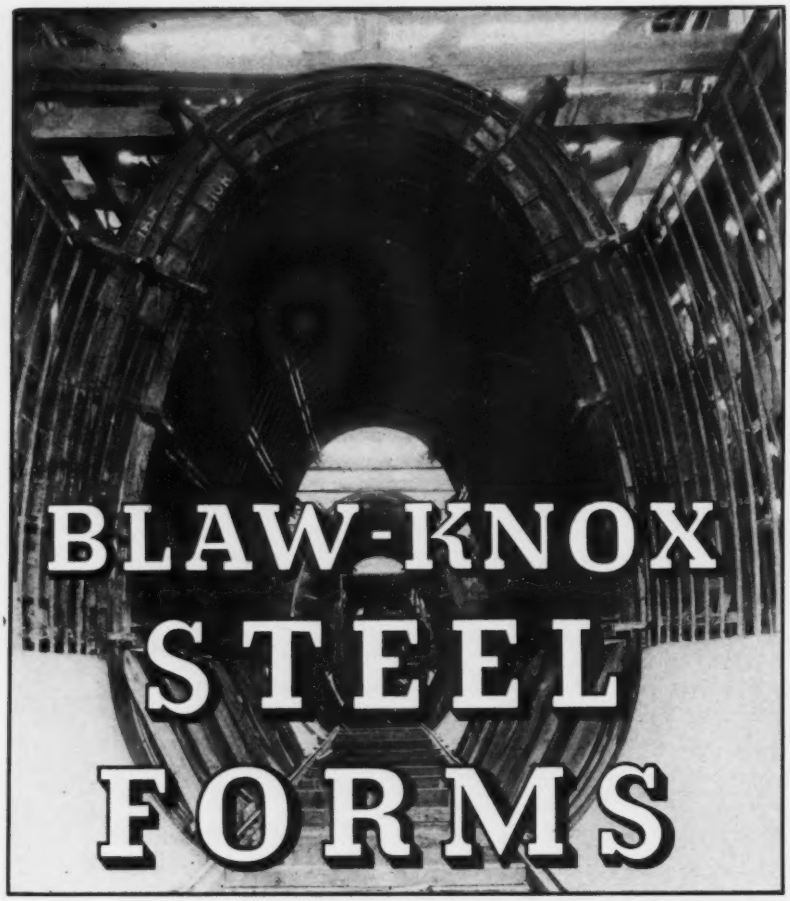
UNITED STATES STEEL

Utilize Blaw-Knox experience in job planning . . . . . .



Blaw-Knox form engineers have the "know-how" to help you plan a concrete construction job so that the work will be done in quick time and at the lowest possible cost.

This is a service which Blaw-Knox has given without charge to engineers and contractors for more than 36 years, resulting in the economical building of thousands of concrete projects, both large and small, with the use of Blaw-Knox Steel Forms.

Current construction work of a sufficiently urgent nature can now be served, and long range planning for the proper handling of future jobs can be aided by experienced Blaw-Knox engineers.

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quickly transporting them to other locations. As independent units, they can be placed for filling while the Towmotor is busy on other jobs, then picked up and hurried to the next destination.—*Towmotor Corp., 1226 East 152nd St., Cleveland, Ohio.*

Ditcher

A recent invention, said to be of particular interest to state and county highway departments, is the Hystevator ditcher, illustrated here. After more than a year of testing, it has been released for production. Its primary function is maintenance of ditches along all types of highways. When ditches fill up from slides, drainage systems cannot function and damage results, frequently attaining the proportion of washouts. The Hystevator is also used by the maintenance crews to load rock and asphalt for patching ravelled spots in the pavement. One man operates the bucket in the ditch, the driver remains in the truck and a third man may occupy his time trimming the ditch by hand for improved appearance in a typical operation. It is claimed that a three man maintenance crew as above can clean about three times the ditch mileage with the Hystevator than it can do without it.

The apparatus can be used on any standard make of truck, is quickly installed or removed, and is simple to operate.—*Willamette Hyster Co., Portland, Ore.*

Extension Light

Adding to its line of specialized safety equipment for industry, the Davis Emergency Equipment Co., has designed a new safety extension light that is said to be absolutely safe against electric shock, even when the guard is removed. The light has a guard of heavy fibre and a new type of spring contact exclusive with

The Extra Power in SKILSAW DRILLS means Extra Speed IN WAR CONSTRUCTION!

SKILSAW DRILL Model 101 (⅝ in Special Duty) speeds up drilling in roof truss construction. Easy to handle, yet it has plenty of drilling power.

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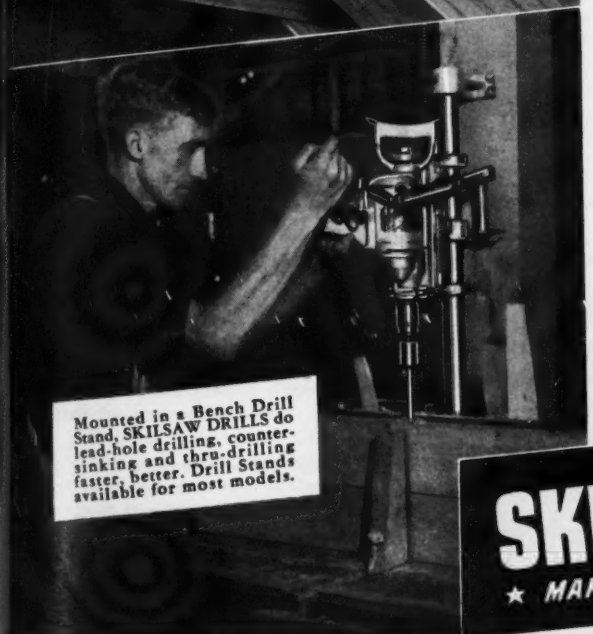
SKILSAW DRILLS are amply powered for deep wood boring in timbers . . . on roof truss construction, bridge building, dams, superrstructures and all other heavy drilling jobs.



Mounted in a Bench Drill Stand, SKILSAW DRILLS do lead-hole drilling, countersinking and thru-drilling faster, better. Drill Stands available for most models.

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ARE BITING INTO FROZEN GROUND and TROPIC MUCK

• Williams Buckets are very much in active service in the wide-flung war offense. Concrete-hard, frozen ground is being broken by the sharp teeth of Williams Buckets in far north road building. Deep in jungles Wellman Buckets are digging and dredging. At ore mines, over stock piles and railway cars, and in steel mills Williams Buckets are literally moving mountains to help beat the Axis.

ARMY E NAVY

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SAFETY HOOKS

Capacities from 3 to 20 tons

DERRICKS • WINCHES • SHEAVES

DIESEL • ELECTRIC • GASOLINE • STEAM

The OHIO LOCOMOTIVE CRANE CO.

BUCYRUS ... OHIO

the company. It is so designed that the guard serves as the on-and-off switch and when the guard is unscrewed the current is automatically cut off.—*Dunn Emergency Equipment Co., 45 Halleck St., Newark, N. J.*

Dispersion Admixture

Santorized Trimix Liquid is offered as a material that improves the dispersion of cement particles and permits reduction of the water ratio as well as improving the compressive strength characteristics of the concrete. This is accomplished by the principle of greater wetting by means of additives having greater surface activity. These results are achieved without in any way interfering with the normal hydration cycle

of portland cement. Slump tests show that when the Santorized Trimix is added to the gaging (mixing) water in proper proportion, the slump of a normal 1:2 mix ranges from 6 to 7 in. as compared to 2½ in. with the same amount of plain gauging water. Higher strength is obtained because the method imprisons the gauging water used, resulting in more thorough curing. It is said to also eliminate the tendency of water to segregate from the cement and aggregate particles and to produce concrete and mortar of greater water tightness, durability and less shrinkage.—*L. Sonneborn Sons, Inc., 88 Lexington Ave., New York, N. Y.*

Drafting Aid

Pencil drawings may be precision-ized and sharp prints can be made without inking through the use of the no-ink drawing board top, according to the manufacturer. The top is said to cut production time now occupied in inking pencil drawings and will restore worn-out drawing boards. The cover is washable, has an estimated life of from 8 to 10 years, and eliminates the use of manila paper.—*The W. H. Long Co., 425 North Clark St., Chicago, Ill.*

"Gulf Quality Lubricants are good job insurance,"

say many leading contractors—on all types of construction projects

"Wartime restrictions on repair parts and new equipment make proper lubrication a must."

NOW that new equipment and repair parts are hard to get even with high priorities, proper lubrication is a vital necessity for the completion of a tough job on schedule," says a highway contractor. "More than ever we rely on the quality lubricants recommended by a Gulf Service Engineer—they give our equipment all-weather protection, help us steer clear of breakdowns and mechanical troubles."

More and more leading contractors with heavy work schedules are standardizing on Gulf higher quality lubricants and getting the benefits of Gulf cooperative engineering service. For they know that breakdowns and mechanical troubles are serious matters today—and that costly delays can be prevented by closely following Gulf Engineering recommendations.

You, too, will find it *good insurance* to use Gulf quality lubricants on your next contract. Call in a Gulf Service Engineer today and ask him to check over your equipment. He will recommend lubricants of greater stability and stamina that are exactly suited to your equipment and operating conditions.

The services of a Gulf engineer—and the Gulf line of more than 400 quality lubricants—are available to you through 1200 warehouses located in 30 states from Maine to New Mexico. Write or 'phone your nearest Gulf office today.

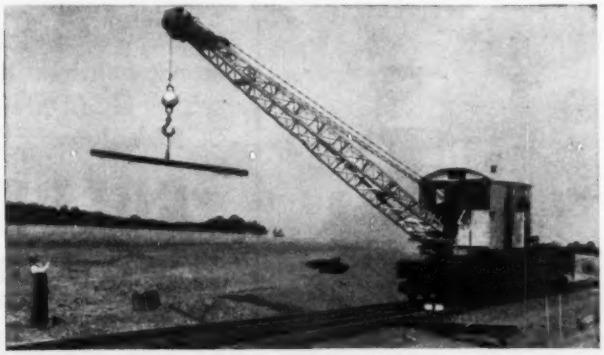
For Victory Buy United States War Bonds and Stamps

GULF REFINING COMPANY
GULF OIL CORPORATION
Gulf Building, Pittsburgh, Pa.

GULF

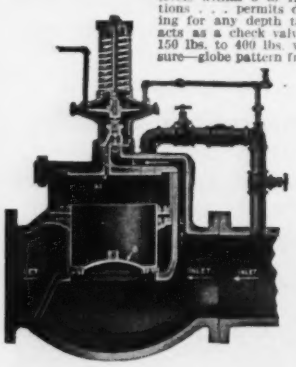
Benjamin Foster Company, Philadelphia, Pennsylvania, is removing a hazard to important defense plants at York, Pennsylvania, by widening and deepening the channel of this stream. Gulf lubricants insure this contractor against breakdowns to equipment under the severe service conditions encountered on this job.

Hinman Brothers, Pittsburgh, Pennsylvania, are grading and paving 3½ miles of highway in the reconstruction of Route 40 near Somerfield, Pennsylvania. The contractor gives Gulf lubricants and fuels a large share of the credit for their being well ahead of a tough contract schedule.

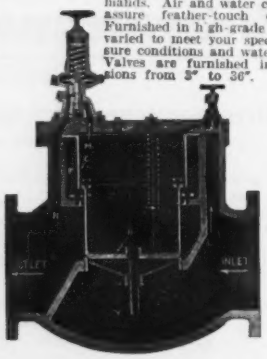


Ferguson and Edmundson are laying 46 miles of railroad track in this munitions dump in Pennsylvania. This contractor uses Gulf lubricants and fuels to insure against unnecessary time out for their equipment on this urgent job.

ALTITUDE CONTROL VALVES . . . a single or double acting unit that maintains water levels within 3 to 12 inch variations . . . permits delayed opening for any depth tank. It also acts as a check valve. Comes in 150 lbs. to 400 lbs. working pressure—globe pattern from 2" to 36".

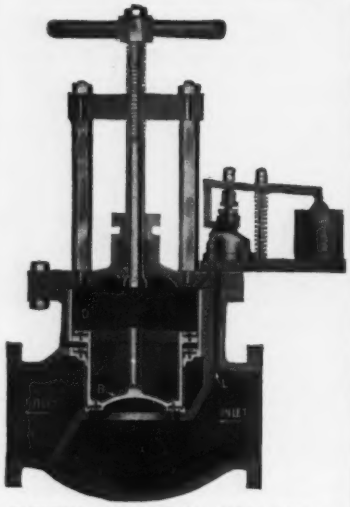


WATER REDUCING VALVES . . . features a perfectly balanced pilot control, able to cope with any flow demands. Air and water cushioning assure feather-touch operation. Furnished in high-grade materials varied to meet your specific pressure conditions and water service. Valves are furnished in dimensions from 3" to 36".

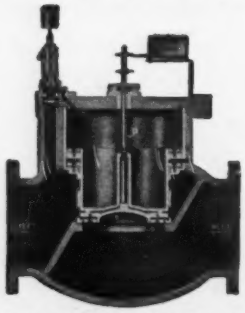


G-A VALVES

. . . FOR EFFICIENT, LOW-COST SERVICE



ELECTRIC AND MANUAL WATER SERVICE VALVES . . . suitable for either remote electrical control or "on-the-spot" manual service . . . arranged to open or close automatically as the solenoid is energized or de-energized. Solenoid comes for AC or DC circuit, for any voltage. Valve is furnished in sizes from 3" to 36", globe and angle types.



ELECTRIC DOUBLE CUSHIONED CHECK VALVE . . . for use in connection with remote tank storage service with valve located adjacent to motor centrifugal pump, also where a high-low pressure or float-operated switch located at tank is wired to the valve to accomplish complete automatic sequence of operation for starting and stopping the pump. Sizes 3" to 36", angle and globe patterns.

Insure uniform service pressure and sufficient capacity to meet varying demands . . . specify GOLDEN - ANDERSON Valves. Included in the G-A line of valves is a wide variety of Water Pressure Reducing Valves, Single and Double Acting altitude Valves, Electric and Manual Water Service Valves—a type and size to meet any continuous service demands. Safe, reliable, low-cost service can be yours . . . guard your water lines and storage tanks by specifying GOLDEN - ANDERSON Valves.

GOLDEN-ANDERSON VALVE SPECIALTY COMPANY

1300 FULTON BLDG.
PITTSBURGH, PA.

MANUFACTURERS' ACTIVITIES

Dr. G. Potapenko, formerly an associate professor of physics at the California Institute of Technology, has been appointed technical director of the Aircraft Specialtites Co., of Los Angeles, Cal. Dr. Potapenko will continue to teach at the Institute. Prior to his arrival in the United States in 1930 as a Fellow of the Rockefeller Foundation, Dr. Potapenko was professor of mining and agriculture at the University of Moscow, Russia, where he received his early education.

The Hyatt Bearings Division of the General Motors Corp. at Harrison, N. J., has been awarded the Army-Navy "E" award for exceptional achievement in the production of war equipment.

The Oil City Tank & Boiler Co. of Oil City, Pa., has changed its name to Electroweld Steel Corp. There have been no changes in the management or directors. The product of this widely known boiler company has been discontinued permanently and the entire manufacturing facilities are now devoted to the production of Electroweld tubing.

G. Stewart Crane, vice president in charge of sales, engineering, development and advertising of Cutler-Hammer, Inc., of Milwaukee, Wis., has been selected by the Milwaukee Advertising Club as the man of the month for January.

Curtiss Ginn, Jr., has been elected first vice president and general manager of the F. E. Myers & Bro. Co., pump manufacturer of Ashland, Ohio.

Rudolph R. Cubicciotti is now associated with L. Sonneborn Sons, Inc., 88 Lexington Ave., New York City, refiners of petroleum products and manufacturers of paints and waterproofings. Formerly employed by the Union Oil Co. of California, Mr. Cubicciotti's diversified experience and thorough grounding are considered assets in his present capacity

G-E WIRING MATERIALS for War Projects

To Use for
WIRING SYSTEM MAINTENANCE,
CONVERSION OR NEW WIRING

PHOTO THROUGH COURTESY OF ALBERT KAHN ASSOCIATED ARCHITECTS AND ENGINEERS, INC., DETROIT, MICH.

Many G-E wiring materials including Fiberduct underfloor raceways were used in this new Midwest war production plant.

ELECTRICAL wiring systems are vitally important to war projects. They are the nerve centers. They govern the production schedules of factories, determine the usefulness of warehouses and regulate the efficiency of many other war projects.

General Electric can offer the high quality, uniform wiring materials necessary for the wiring systems of all sorts of war projects. Many years of successful manufacture are behind this offer. The General Electric monogram appearing on these products has long been a symbol of dependability and long life.

The G-E line of wiring materials is the only complete line on the market. It includes conduit, Fiberduct, boxes and fittings, wires and cables, BraidX, bus drop cable, cords, switches, outlets, lampholders, fluorescent lamp starters, fuses, etc. These materials are carefully made according to rigid specifications.

G-E wiring materials distributors are located at key points all over the country. They all handle materials suitable for wiring system maintenance, conversion or new war project wiring. *One of these distributors is located near you.*

For further information on G-E wiring materials, see the General Electric Merchandise Distributor near you or write to Section CDW2311-113, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

KEEPING JOE

WARM IS YOUR IMPORTANT JOB

REZNOR Unit Heaters Will Do It

When properly located, Reznor Suspended Gas Fired Unit Heaters will heat an entire manufacturing plant economically — no cold, forgotten corners — every employee works where temperatures are RIGHT. Furthermore, the Reznor system may be installed in less time . . . saving man hours . . . requiring 89% less of vital materials . . . and reducing installation costs. Write for complete catalog today.

REZNOR MANUFACTURING CO.
105 JAMES ST. MERCER, PENNA.

"GAS HEATERS EXCLUSIVELY SINCE 1888"

as executive assistant to JULIUS F. ROTEN, vice president of the company.

LEON E. JENNERET, formerly assistant general sales manager of the BABCOCK & WILCOX TUBE CO., has been appointed manager of sales of the welded tube division of the company, with general offices and plant at Alliance, Ohio.

Three promotions have been announced by W. A. ROBERTS, manager of the ALLIS-CHALMERS TRACTOR DIVISION, involving changes in the company's sales and engineering organizations. They are: A. W. VAN HERCKE (top left), promoted from sales manager to assistant manager of the tractor division, to coordinate all engineering and development work; A. F. MCGRAW (center), from sales promotion manager to general sales manager, heading up industrial and agricultural sales of the tractor division; and R. A. CROSBY (lower left), of the advertising department, temporarily loaned to the Salvage Section of WPB, will be advertising manager.

Mr. Van Hercke, who has long experience as an implement dealer, agricultural and industrial tractor and equipment salesman and home office sales executive, originally joined the Milwaukee office from the industrial field organization. Mr. McGraw helped to build the pioneer power equipment methods in agriculture and road building and has been a salesman and branch executive in both the industrial and agricultural fields.

G. H. NIEMEYER, president of HANDY & HARMAN, announced recently that his company had been granted a renewal of the Army-Navy "E" award. This gives the company the right to add a white star to the pennant originally awarded last August.

A new organization, LINDSAY AND LINDSAY, of Chicago, formed in January 1943, has purchased from DRY-ZERO CORP. all the assets and business of the former Lindsay Structure Division of that company, for the manufacture and sale of

HYDRO-TITE

HYDRO-TITE — The self-caulking joint compound that makes cast iron water pipe joints — strong — tight — flexible and everlasting. Used on thousands of miles of pipe with a record of more than 30 years without a failure.

•

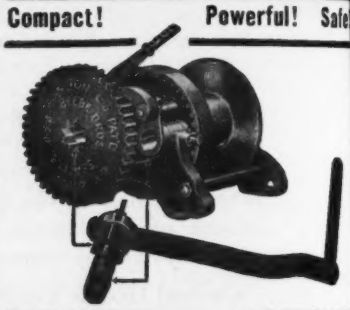
FIBREX — The sanitary paper packing that is used like braided jute. Free from bacteria — treated with a water repellent — put up in 60 pound reels. 70 pounds of Fibrex takes the place of 100 pounds of braided jute.

•

HYDRAULIC DEVELOPMENT CORPORATION
50 Church St.
New York, N. Y.

DRY BRAIDED Fibrex

Compact! Powerful! Safe



DISTRIBUTABLE CONTROLLED POWER with Beebe Bros. ALL STEEL HAND HOIST SEATTLE, U.S.A.

★

Money Has Been Saved on These Jobs

1200' assembled pipe (132 Tons) were lowered to bed of Mississippi at St. Paul with 9—5-Ton Beebes, three lines to each hoist through blocks.
Hudson River Bridge sidewalks were laid in sections with 32—5-Ton Beebes.
Longest wooden trusses in world were installed with ONE 5-Ton Beebe after power hoists proved impractical.

★

When raising, lowering, or placing costs by power are a serious problem, the answer is the right number of Beebe Bros. All Steel Hand Hoists MANNED IN UNISON. Available in 2, 5 and 10 Ton sizes. Sold through leading dealers in all trade centers. List of dealers sent upon request.

BEEBE BROS., 2720 6th Ave. S., Seattle, U.S.A.

★

"THE STRONGEST GEARED POWER FOR ITS WEIGHT IN THE WORLD"

Lock Joint Pipelines Speed Work on Synthetic Rubber Plants

SYNTHETIC RUBBER is vital to the war effort ..and water supply is vital to the production of synthetic rubber.

Reinforced Concrete Pressure Pipe is supplying the immediate need for pipelines, and by being "tailor-made" to fit the job, is conserving thousands of tons of steel urgently needed for the production of armaments.

Probably in no other type of work are there so many special fittings, elbows, tees or wyes required as in the pipelines serving synthetic rubber plants—yet each one of these can be quickly and readily supplied in standard Lock Joint designs.

◆ ◆ ◆ ◆

Whether your project is large or small, your 'phone call, telegram, cable or letter to any of our offices will bring a prompt reply.

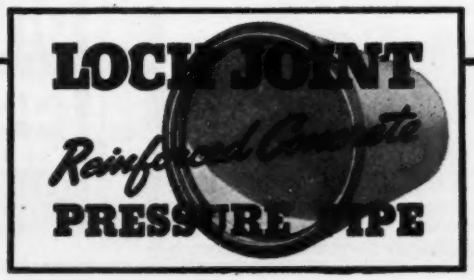
LOCK JOINT PIPE COMPANY

Established 1905

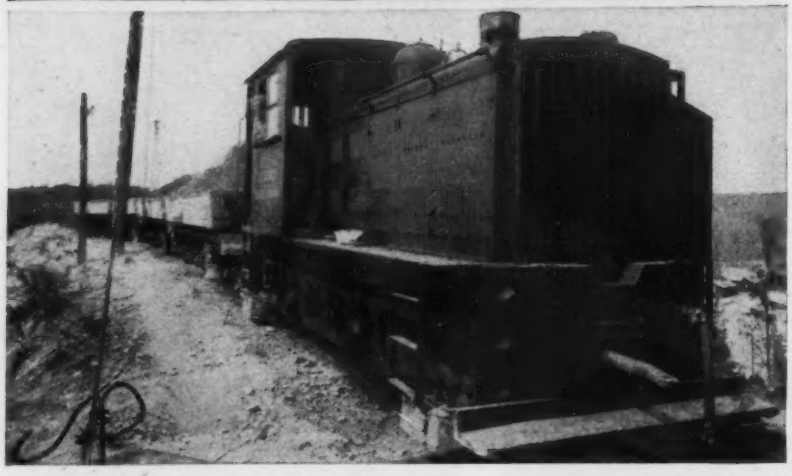
AMPERE, NEW JERSEY

Denver, Colo. • Chicago, Ill. • Kenilworth, N. J. • Kansas City, Mo. • Rock Island, Ill. White Plains, N.Y. • Valley Park, Mo. • Cleveland, Ohio • Hartford, Conn. • Navarre, Ohio

SCOPE OF SERVICES *Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply Mains as well as Concrete Pipe of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous lines.*



A REAL
TUG OF WAR



Plymouth VS. MATERIALS

This is the kind of gruelling contest that Plymouth Locomotives are built for! Plenty of power, speed to spare, an edge on endurance . . . those characteristics make this a safe bet: Plymouths will pull more materials across the Victory line at lower cost than any comparable method of materials haulage.

Efficient track haulage is an essential cog in war-time production, in peace-time planning. Whatever your job it will pay you to write for facts and figures. We'll cooperate in every way possible.

PLYMOUTH GASOLINE and DIESEL LOCOMOTIVES
PLYMOUTH LOCOMOTIVE WORKS
Division of The Fate-Root-Heath Co. PLYMOUTH, OHIO, U. S. A.

BAILEY METERS AND CONTROLLERS

FOR SEWAGE TREATMENT AND WATER SUPPLY . . .

● Venturi Tubes, Weirs, Flumes, Nozzles and other primary elements; Mechanically and Electrically operated Registers and Complete Automatic Control Systems.

BAILEY METER COMPANY
1029 IVANHOE ROAD • CLEVELAND, O.
Bailey Meter Co. Ltd., Montreal, Canada

NEED A BIG Trailer?

La Crosse Makes Them Up To 200 Ton Capacity-
** WRITE OR WIRE **
LA CROSSE TRAILER & EQUIPT. CO.
LA CROSSE, WISCONSIN U. S. A.

Lindsay structures, a method of [illegible] steel construction. HARVEY B. LINDSAY, until now president of the Dry-Z[illegible] Corp., resigned to direct the activities of the new organization. Offices of Lind[illegible] and Lindsay are located at 222 W[illegible] Adams St., Chicago, and 60 East 42[illegible] St., New York City.

THE ATLAS POWDER CO. of Wilmington, Del., has announced the appointment of RALPH K. GOTTSHALL, of Seattle, Wash., as director of sales of the explosives department, in full charge of the sales division and all its activities. Mr. Gottshall has been manager of the company's Northwestern district with offices in Seattle, but will now be stationed in Wilmington, Del., at the company's general offices. At the same time, it was announced that WILLIAM T. MAHOOD has been appointed manager of the Northwestern district.

A. W. BAKER has been appointed transportation specialist of the GENERAL ELECTRIC CO.'s Atlanta, Ga. office transportation department.

CHESTER F. CONNER, manager distributor sales, industrial products division, the B. F. GOODRICH CO., has been appointed to the staff of advisers on mechanical rubber goods in the Office of Rubber Director, War Production Board, Washington, D. C.

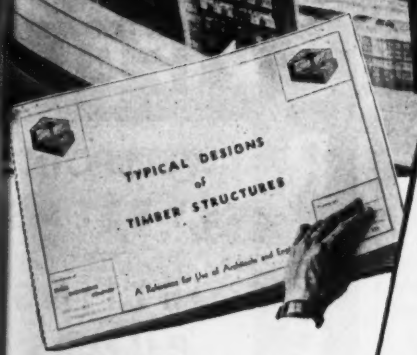
JAMES H. DEADERICK, assistant general parts manager of CATERPILLAR TRACTOR CO. since February, 1941, has been named a vice president of the company, with administrative direction of the parts, service and traffic departments. A native of Santa Barbara, Cal., Mr. Deaderick engaged in the contracting business before joining the Caterpillar organization.

The MANHATTAN RUBBER MFG. DIVISION of RAYBESTOS-MANHATTAN, INC., has entered its fiftieth year of active service, since its founding on Oct. 28, 1893.

JOSEPH V. SULLIVAN, for 26 years an employee of the EQUIPMENT CORPORATION OF AMERICA, has been elected president of the corporation at a recent annual meeting. M. E. JOST and L. T. KERN were elected vice presidents, and H. M. CAPRON has been advanced to the post

Timber Tanks

SOLVE ANOTHER MUNICIPAL PROBLEM



TECO RINGS Solve Many Engineering Problems

This book brings you, without cost, 45 Typical Designs of Timber Structures—Roof Trusses for all purposes, Bridges and Trestles, Towers, Grandstands, Markets, Wharves, Bins. Just write us today for your *Free* copy, using your professional letterhead. Address Timber Engineering Company, 1319 Eighteenth Street, N. W., Washington, D. C.

200,000 TO 2,000,000 GALLONS

for Water . . Oil . . Sewage

High-capacity storage tanks of wood are now available to municipalities as a result of this radically new, war-born design.* The staves, prefabricated, are built up *horizontally* so that, for the first time, their structural strength is brought into play. The staves, themselves, take the tension from the pressure of the fluid contents—instead of serving merely as the wall of the tank, as in the familiar *vertical* stave construction. Need of steel banding is entirely eliminated . . . two-thirds less steel is used . . . and one-half less lumber.

TECO Split-Ring Timber Connectors, embedded in all joints, provided the high-efficiency union of members which made this design possible.

These tanks are of great strength. They are long-lived. And, they are very economical. For detailed data, address the fabricators, Henry Mill & Timber Co., Tacoma, Washington.

* *Patented*

The TECO Ring Connector spreads the load on a timber joint over practically the entire crossection of the wood.

Timber ENGINEERING COMPANY

WASHINGTON, D. C. **PORTLAND, OREGON**

YOUR TUNNEL LINER Is a "Patriot" Too

(PHOTO BY U. S. ARMY SIGNAL CORPS)

Old, familiar friends have taken new shapes and gone to war. Now ARMCO Tunnel Liner Plates can be purchased only for the most vital war-time projects.

Where metal tunnel liner *must* be used, ARMCO Plates are doing their part and more. They save precious metal because gage for gage this heavy duty liner is stronger (section modulus) than any other plate. Less metal is required to do the work. When completed rings can be spaced to take advantage of partly self-supporting ground, fewer plates may actually be used. Work moves fast; for one man can handle and assemble the light sections with structural wrenches.

If you cannot get ARMCO Tunnel Liner Plates, remember the steel is going into tanks, guns and ships—helping to win battles. After the war these liner plates will be back to help you cut costs and speed tunnel work. Armco Drainage Products Association, 115 Curtis St., Middletown, O.

ARMCO

ARMCO

TUNNEL LINER PLATES

of chairman of the **Board of Directors.**

I. H. ANDERSON has been named district manager of sales for the steel and tubes division of REPUBLIC STEEL CORP. in New York.

WILLIAM W. DUNNELL, JR. has been appointed to the staff of the Division of Industrial Cooperation of the Massachusetts Institute of Technology, terminating a 10 year connection as chief engineer of the Reece Button Hole Machine Co. of Boston.

EUGENE E. WEYENETH, formerly publicity director for the R. G. LETOURNEAU, INC., has been promoted to the advertising department. He is succeeded as publicity director by ROLAND S. NEFF.

LOUIS F. THEURER, industrial sales manager for the paint division of the Milwaukee branch of the PITTSBURGH PLATE GLASS CO., has been named West Coast divisional manager succeeding Floyd S. Green, who is retiring.

THERON P. PALMER, president of the CONTINENTAL RUBBER WORKS, at Erie, Pa., was one of those in attendance at recent ceremonies at the company's plant marking presentation of the joint Army-Navy "E" award for excellence in production. Brig. Gen. Ray L. Avery made the presentation on behalf of the army.

The TRIANGLE ENGINEERING CORP., formerly located at 16 Court St., Brooklyn, N. Y., has moved to new offices at 101 Park Ave., New York.

The ANTHOHY CO., INC., recently was presented the Army-Navy "E" award at its plant No. 1 at Streator, Ill.

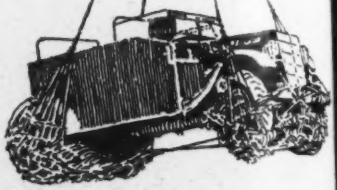
Employees and members of the management of the BARRETT DIVISION, ALLIED CHEMICAL & DYE CORP.'s Frankford, Pa. plant, recently received the joint Army-Navy "E" for excellence.

Election of RICHARD A. HUTCHINSON, HERBERT M. PRIOR and EINAR HAMMER as directors of the Visible Index Corp. was announced recently. Mr. Hutchinson is vice president of the Studebaker Corp.; Mr. Prior is vice president of the Continental Bank & Trust Co., and Mr. Hammer is president of L. W. Minford & Co.

HARRY D. SIEGELE, for 40 years connected with the BELMONT IRON WORKS in the capacity of structural engineer, salesman and director of the company died Jan. 31.

Lidgerwood hoists

WAR AND INDUSTRIAL LOADS



Hoists, Capstans, Cargo and Boat Winches, Towing Machines, Cableways

BUILDERS of fine HOISTING MACHINERY for Over 69 years

Electro-Hydraulic Steering Gears, Windlasses, Special Winches

We Proudly Fly These Banners—

U. S. Treasury Award Army-Navy "E"

LIDGERWOOD Established 1874

MANUFACTURING COMPANY

Main Office and Works ELIZABETH, NEW JERSEY

GRIFFIN

GRIFFIN

WELLPOINT SYSTEMS

JETTING PUMPS

FOR SALE RENT

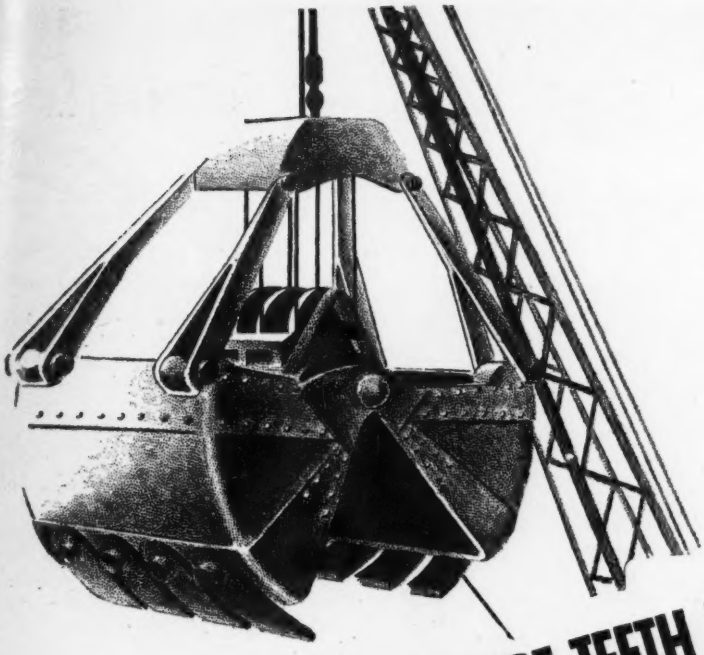
Prompt Shipments

Send for our New 60 page illustrated catalog "GRIFFIN POINTED WELLPOINT FACTS" chock full of latest information on Wellpoint Systems for dewatering, emergency and permanent water supply systems, also information on pressure pumps and data for jetting.

GRIFFIN WELLPOINT CORP.

881 EAST 141st ST. • NEW YORK, N. Y.

Phones: MElrose 5-7704-5-6



HOW TO AVOID HAVING THESE TEETH KNOCKED OUT!

This crane's earth-devouring jaws are only as effective as the grease-and-oil protected cables, engines and steel treads that help motivate them.

Now, with every minute and every machine vital to your job, you can't afford to have those teeth "knocked out" of service through defective lubrication.

Cities Service's tough, tenacious Cisco Compounds and Trojan Greases are built to stick to the job through rain and snow and burning sun—in continuous 24-hour or intermittent service.

Whether your work calls for one or many types of lubricants—Cities Service is ready to serve you with service-proved, quality products and expert lubrication counsel.

Your nearest Cities Service office will be glad to give you further particulars.

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY
NEW YORK • CHICAGO

IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Wote Tons per Hour

WITH AN I. B. BUCKET

Properly designed—as a result of over 50 years experience—Industrial Brownhoist buckets are light in weight yet of extra sturdy construction. Large sheaves reduce rope wear and maintenance to a minimum. Deep clean bites practically eliminate hand shoveling. Standard types (rope-reeve, power-wheel, link-type) in stock for immediate delivery. Write for complete information.

INDUSTRIAL BROWNHOIST

BAY CITY, MICH. • DISTRICT OFFICES: NEW YORK, PHILADELPHIA, PITTSBURGH, CLEVELAND, CHICAGO

PLUMBING DATA *For Ready Reference*

- - - Immediate Use!

PLUMBING PRACTICE AND DESIGN

by SVEND PLUM

Volume I **308 Pages** **Illustrated** **$4.50**

This book is of prime importance to architects, engineers, plumbers, and draftsmen. All the data on plumbing—usually found scattered in various technical literature—are now consolidated and presented in simple usable form. The definitions, drawings, tables and principles presented, will prove an immense help to anyone whose work totally or partially is concerned with plumbing.

CONTENTS VOLUME I

Corrosion — Materials — Pipe and Fittings — Valves and Controls — Fixtures and Accessories — Pumps — Fire Protection — Air Piping and Equipment

Publication of Volume II Scheduled for April
(Probable Price $4.50)
ORDER YOUR COPY OF VOL. II TODAY

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Please send me a copy of Plum's PLUMBING PRACTICE AND DESIGN. Vol. I ☐ and Vol. II (when ready) ☐ on ten days' approval. At the end of that time, if I decide to keep the book, I will remit ☐ $4.50 or ☐ $9.00 plus postage; otherwise I will return the book (books) postpaid.

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ENR-2-43

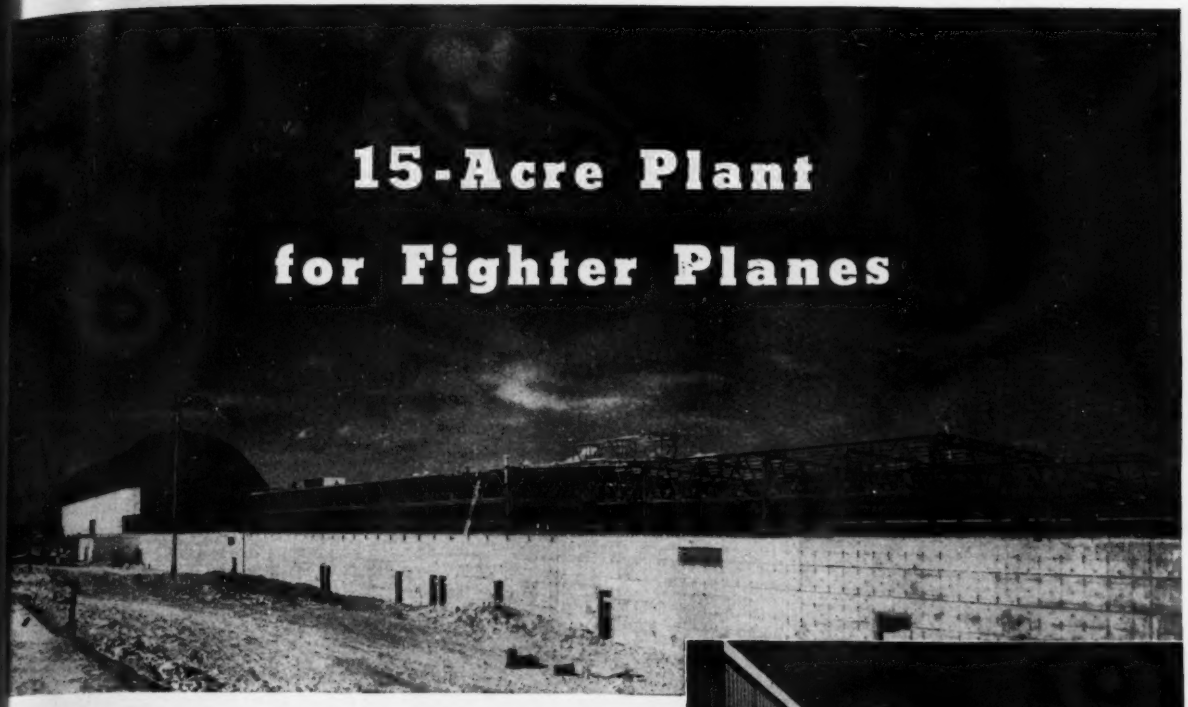
Gypsum—The Certain-teed Products Corp. has just issued a new bulletin announcing the addition of two new members to its family of non-critical materials developed especially to speed up wartime construction. They are known as Bestwall Gypsum Exterior Board and Certain-teed Gypsum Laminated Roof Decking. Each is said to have numerous applications in wartime buildings in place of critical materials that are no longer available. The gypsum exterior board sheathes, sides and insulates. The laminated roof decking is made up of panels of Bestwall gypsum board, and is said to be remarkably strong and fireproof, easily and quickly applied.—*Certain-teed Products Corp., 120 S. LaSalle St., Chicago, Ill.*

Cooling Plants—Sheet No. 21, showing details of roof pipe supports for cooling towers and spray systems, has been made available by the Water Cooling Corp. The Watco roof cooling system, designed to prevent transmission of the outside solar heat through building roofs, resulting in lower inside building temperatures, are equipped with these pipe supports in addition to the company's spray nozzles and other attachments, described in similar catalog sheets also available.—*Water Cooling Corp., 71 Nassau St., New York City, N. Y.*

Ion Exchangers—As a logical development of nearly thirty year's experience with the application of ion exchangers to water conditioning processes, the Permutit Co. has recently gone into the field of ion exchange for non-water conditioning uses. This expanded scope of application is described in a booklet "Ion Exchangers for Industrial Processes" which is now available.—*The Permutit Co., 330 West 42nd St., New York, N. Y.*

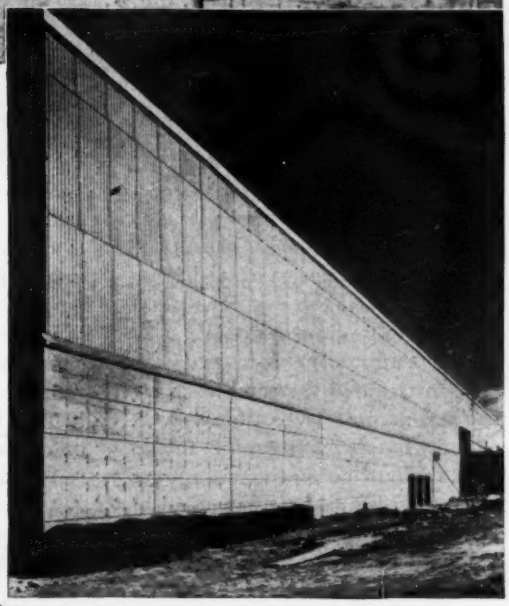
Valves, etc.—One of the most widely distributed books available to the industry today is a 32 page booklet entitled "Where to Use Valves, Drains and By-Passes" issued by Jenkins Bros. The booklet tells which valves to use, differences among the various types of valves, fundamentals of value designs and application, where to use by-passes or drains, metal compositions of Jenkins valves and lists A.S.M.E. power boiler code valves.—

15-Acre Plant for Fighter Planes



Somewhere in America the Sikorsky Plant, shown here during the period of construction, is now turning out large numbers of the latest type fighter planes for the Navy. This plant covers an area of 652,500 sq. ft., is completely windowless and is 100 per cent, fireproof.

An unusual feature of the Sikorsky Plant is the walls. On the west side of the building, shown above and right, is a bomb-fragment-proof wall, of 10-in. reinforced concrete, 15 ft., 4 in. high. This is designed to provide air-raid protection for employees, as well as protection for emergency hospital, vault, general offices, and other key elements. The other walls of the structure are of corrugated asbestos composition, $\frac{5}{8}$ in. thick, backed up by $1\frac{1}{2}$ in. of insulation. These walls rest on steel girths so that, should a bomb hit, only bays actually demolished need be replaced. Fire curtains are included to prevent the spread of fire to any other section of the plant.

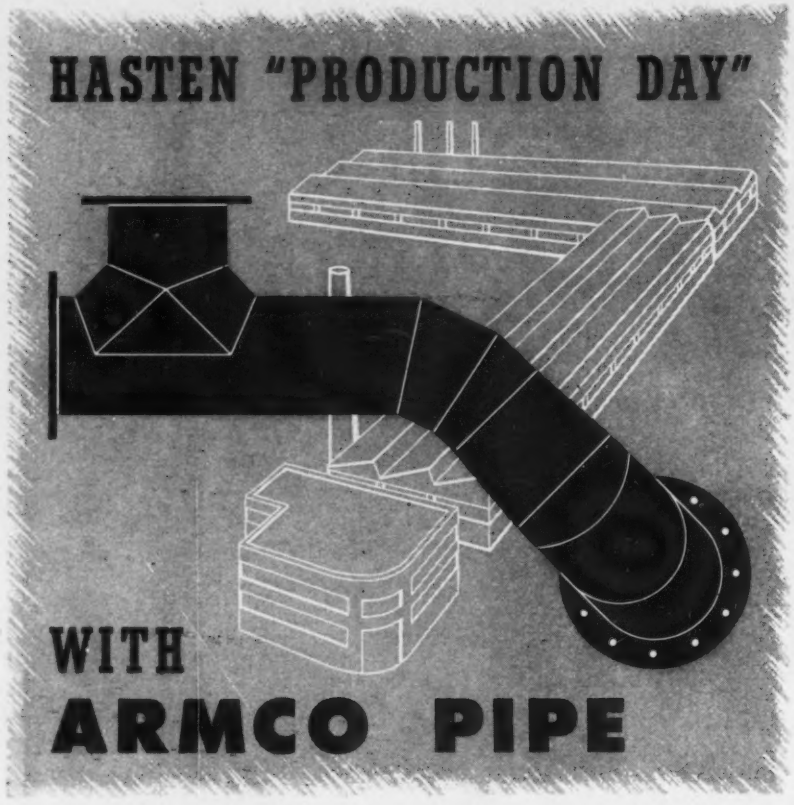


Architects and Engineers: J. Gordon Turnbull, Inc.
Contractors: Clemmer Construction Co.

Construction has provided a 40-ft. ceiling throughout. There are four aisles, 1050 ft. long, with 100-ft. spans, and one 450-ft. aisle with a 200-ft. span and two aisles with 100-ft. spans. A cafeteria on the main floor accommodates 600. General offices and storage space are located on a mezzanine which runs along one side of the rectangular structure for a distance of 1000 ft. Fabrication and erection of the 8000 tons of structural steel were carried out by the Bethlehem Steel Company.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL



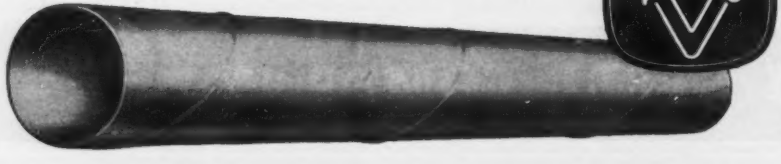
If your job is to build new plants in a hurry, here's a timely tip: ARMCO Prefabricated Process Steel Piping will help speed the day your plant swings into the war effort.

With "Spiral Welded," even the most intricate pipe assemblies go in fast and accurately. ARMCO's method of pre-fabricating pipe means that standard or special fittings are made-to-order and come welded to straight pipe runs. This eliminates a pair of flanges at every bend, reduces weight, and saves hours of tedious assembly. Efficient operation is also assured. ARMCO Pipe is smooth inside for high flow capacity and is easy to keep clean.

Learn how ARMCO Spiral Welded Steel Pipe can help speed important war construction. You'll find it ideal for plant piping, water, gas or oil, as well as for low pressure steam lines. Write for prices and shipping promises. The American Rolling Mill Co., Pipe Sales Division, 341 Curtis Street, Middletown, Ohio.

STANDARD SPECIFICATIONS	
Sizes 6 in. to 36 in. Wall .060 in. to .172 in.	A. S. T. M. Designation: A 211-40
Sizes 8 in. to 30 in. Wall .188 in. to .312 in.	A. S. T. M. Designation: A 139-39
Sizes 30 in. to 36 in. Wall .188 in. to .500 in.	A. S. T. M. Designation: A 134-39

ARMCO SPIRAL WELDED PIPE



Jenkins Bros., 80 White St., New York.

Diesel Engines—Two new models have been added to the line of diesel engines produced by the Murphy Diesel Co., making a total of five now available. The line now offers Model ME-4, 90 hp. continuous, 105 hp. intermittent; Model ME-46, 100 hp. continuous, 115 hp. intermittent; Model ME-6, 135 hp. continuous, 160 hp. intermittent; Model ME-66, 150 hp. continuous, 180 hp. intermittent; Model ME-650, 165 hp. continuous, 200 hp. intermittent. Complete information on these machines is available in a series of booklets and catalog pages issued by the company.—*Murphy Diesel Co., 5317 W. Burnham St., Milwaukee, Wis.*

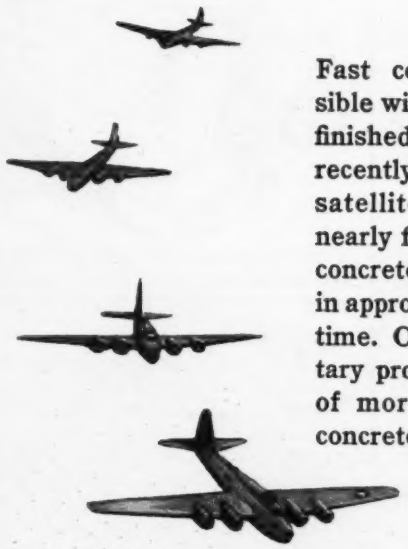
Safety—Cooperating with a campaign for further prevention of industrial accidents, Catalog 50, containing 144 pages, has been released by the Boyer Campbell Co. Included in the pages of the catalog are hundreds of products that take in every phase of the safety problem.—*Boyer Campbell Co., 6540 Antoine, Detroit, Mich.*

Care of Compressors—Suggestions for better operation and maintenance of air compressors and equipment are contained in a series of articles prepared under the title "Proper Care of Compressed Air Plants." A more exhaustive coverage of the subject is contained in pamphlets "Trade Standards." Both are available from—*Compressed Air Institute, 90 West St., New York, N. Y.*

Rubber—In view of the present rubber shortage, engineers will be interested in a booklet "How to Lengthen the Life of Mechanical Rubber Goods" issued by the Pioneer Rubber Mills Co. The book contains a foreword explaining why Pioneer Rubber Mills is in a particularly strategic position to make this release to industry. The booklet contains field-practical pictures and explanations of proven ways to increase service from rubber belting and hose and concludes with a new idea in conservation—the marking of industrial rubber in daily use within the plant by means of attractively designed tags, furnished without charge by the manufacturer.—*Pioneer Rubber Mills, 353 Sacramento St., San Francisco, Cal.*

Zinc—A useful, attractive booklet containing fresh information on Armco Zincgrip, and helpful suggestions on specifying, ordering, fabricating and finishing this special zinc-coated sheet metal has been published by the American Rolling Mill Co. The file-size 26 page booklet is designed to assist purchasing agents, engineers, plant executives, foremen and workers in using Armco Zincgrip.—*American Rolling Mill Co., 750 Curtis St., Middletown, Ohio.*

Concrete's ready for War Birds



cepted methods enable engi-ers to design concrete pavements sustain safely the wheel loads the heaviest bombers or giant nsports. Adequate strength for e most severe service is provided th concrete pavement using a inimum of reinforcement and thout wasteful thickness of slab. esign tables requiring a minimum calculations are available for heel loads up to 180,000 pounds. Modern concrete airport pave-ents give all-weather service with ttle maintenance expense—stay n the job year after year without stly rebuilding.

BUY MORE WAR SAVINGS BONDS

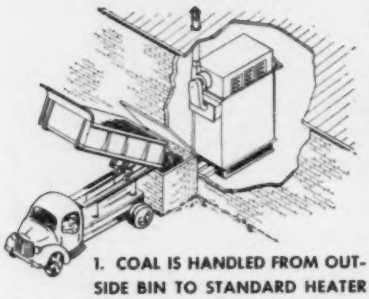
Fast construction methods possible with concrete get urgent jobs finished at war speed. In one state recently a big army base and eight satellite airfields with a total of nearly five million square yards of concrete pavement were completed in approximately sixty days elapsed time. On several individual military projects daily placing records of more than 20,000 sq.yd. of concrete have been set.

The services of our engineers are available to help expedite war paving projects or solve design problems.

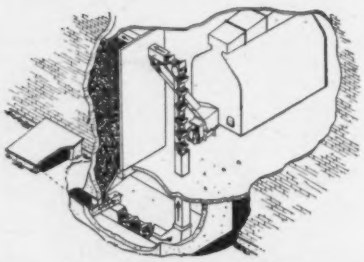
PORTLAND CEMENT ASSOCIATION
Dept. A2d-17, 33 West Grand Ave., Chicago, Illinois

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

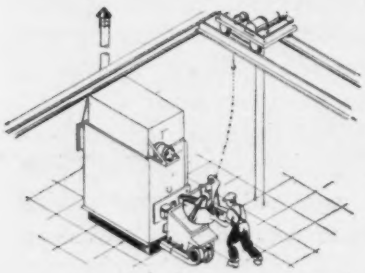
...how to use **Economical direct fired Heating** when coal is the available fuel



1. COAL IS HANDLED FROM OUTSIDE BIN TO STANDARD HEATER



2. COAL IS LOADED IN STORAGE BIN, EMPTIED AUTOMATICALLY TO STOKER HOPPER



3. HANDLING COAL IN CLAMSHELL BUCKET FROM SHOP CRANE TO STOKER HEATER

Those considering new buildings to be heated with coal, or conversion to coal heat of existing structures, are welcome to copies of Dravo booklets 505 and 506.

HEATING industrial plants by means of direct fired warm air heaters fueled with gas or oil has long been an accepted, economical practice. Now Dravo coal fired models also are available for automatic bin, hopper or conveyor feed; hard or soft coal; output 1,000,000 to 8,000,000 B.t.u. per hour. The accompanying drawings show three convenient methods for feeding coal to the stoker.

1. **Bin feed stoker, with adequate storage bin constructed outside building wall, accessible to coal truck.**
2. **Interior storage bin, loaded from outside of building, with bucket conveyor and gravity feed to hopper type stoker (for large capacity units).**
3. **Regular shop crane and clamshell bucket used to load standard hopper feed model.**

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DRAVO DIRECT FIRED HEATERS

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can reduce your construction costs. It is efficient and dependable, an established product.

WE RECOMMEND "GUNITE" for structural steel protection, floor and roof slabs, thin exterior walls, partitions, tanks, reservoirs, restoring disintegrated concrete surfaces, repairing reinforced concrete, etc. Let us suggest how "Gunite" can best solve your problems.

PRESSURE CONCRETE CO.

"GUNITE" CONTRACTORS

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MEN AND JOBS

Robert Hollopeter has become assistant city engineer and **T. C. Schaetzle** has become technical supervisor for Wooster, Ohio.

F. D. Hegge, civil engineer of Seattle, who worked seven years on inspection of dam construction for the Bureau of Reclamation, has been commissioned a second lieutenant in an anti-aircraft artillery unit at Camp Davis, N. C.

H. D. Walker, senior draftsman for the North Carolina State Highway and Public Works Commission, is now a first lieutenant in the U. S. Army.

Lt. Col. Clarence V. Shain has resigned as Thurston county, Wash., engineer, to accept appointment as plans and training officer for the Washington State Guard.

Harry A. Norris has been appointed superintendent of the municipal electric light and power system at New Martinsburg, W. Va.

Svend A. Canariis has entered private consulting practice in pumping application design and procurement, with offices in New York City. Mr. Canariis severed connections with the Pomona Pump Co., with whom he was project engineer, recently.

J. D. Levin, construction engineer, Public Buildings Administration, has been transferred from Bellevue, Neb., to Brownwood, Texas, to supervise construction of a health center there under the War Public Works program.

Maj. Chris. J. Sherlock, president of the American Road Builders' Association, is now chief operations officer for the Skagway, Alaska, district of the Corps of Engineers. He was formerly stationed at Denver, Colo., where he was assigned as operations officer immediately after receiving his commission last June.

C. V. Dunne is now resident engineer with the Naval Service of the Department of National Defense at Sydney, N. S. He was previously construction engineer with the E. B. Eddy Co. of Hull, Quebec.

Lt. Col. Thomas P. Browne is now Commanding Officer of the 403rd Engineer Water Supply Battalion at Camp Butner, N. C.

Sydney M. S. Dunne is now on the staff of Defense Industries, Ltd., at Jean Brillant, Quebec.

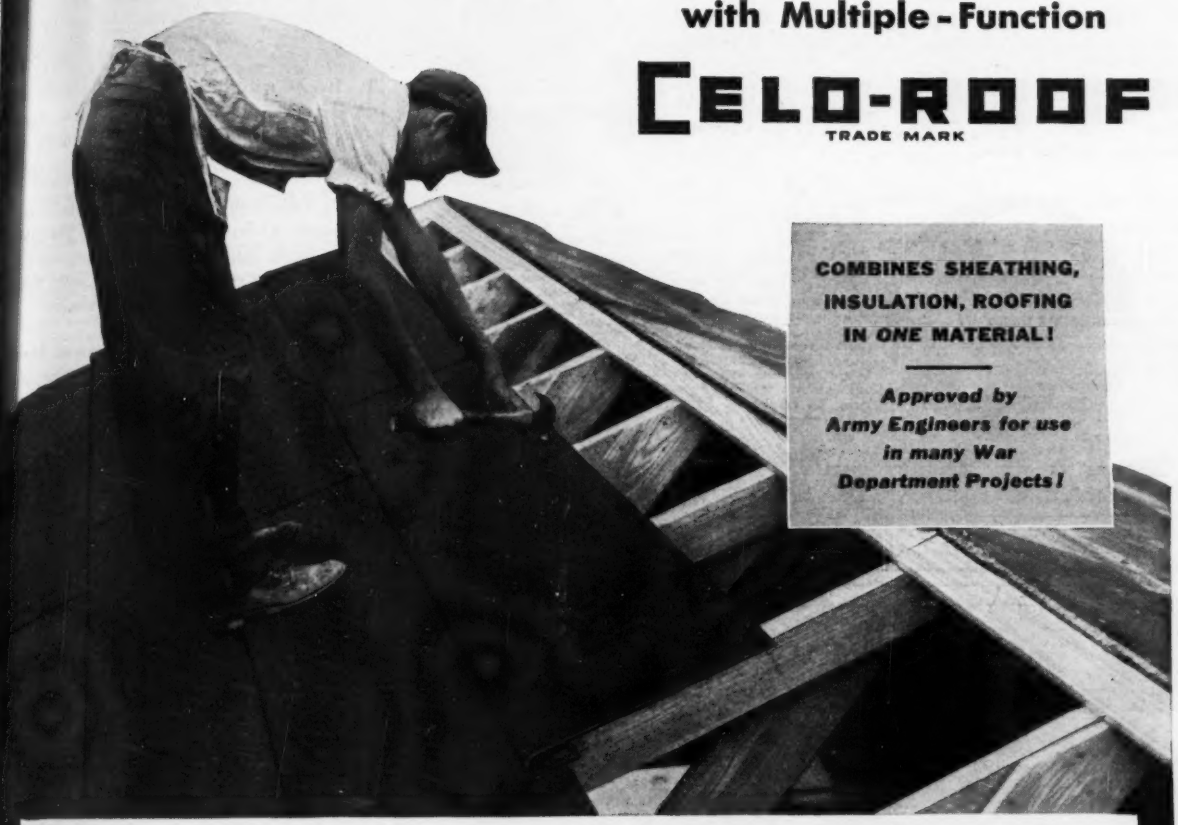
Newton F. Hicks, formerly assistant office

OW AVAILABLE! The Greatest Roofing Improvement in Years!

SAVE CRITICAL MATERIALS—TIME—LABOR

with Multiple-Function

CELO-ROOF
TRADE MARK



COMBINES SHEATHING, INSULATION, ROOFING IN *ONE* MATERIAL!

Approved by Army Engineers for use in many War Department Projects!

Used on Housing Projects, Barracks, Hospitals, Industrial Plants!

CELO-ROOF combines sheathing, insulation, and roofing. It consists of a vapor-sealed Celotex cane fibre core surfaced with a mineral-surfaced roofing, carrying Fire Underwriters Class C label. A beveled wedge cleat, factory-applied on the under side of each unit, provides a tight, rigid, interlocking joint. Each unit is nailed directly to the rafters and eliminates the need for wood sheathing or other types of boards or strips. It saves time, labor, and critical lumber and nails.

Buildings roofed with Celo-Roof are easy to heat, conserve fuel, keep warmer in winter and cooler in summer. And because Celo-Roof is a full inch thick at the butt, it produces a natural shadow line effect, beautiful to look at and giving a true impression of the ruggedness and durability of this new kind of roof.

Celo-Roof is now specified and being used on many important housing developments, as well as on many War Department projects. Barracks, hospitals, industrial buildings and warehouses can be completed faster when Celo-Roof is used. For the present Celo-Roof is not available for individual houses. Get complete information now!

CELOTEX
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ROOFING • INSULATING BOARD
ROCK WOOL • GYPSUM WALLBOARD • LATH
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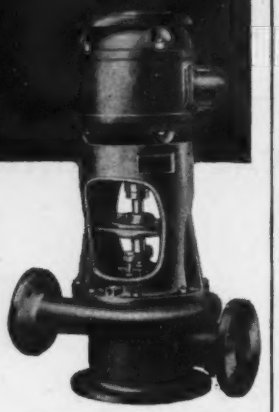
The Pump DESIGNED AND BUILT TO MEET TODAY'S DEMANDS



The new Economy SCV pump is adaptable to almost any pumping job where clear water or liquids are handled. Vertical in design—it saves space and places motor high and dry above its mounting surface. It is built with the stamina to do the job—no costly pump failures to disrupt schedules. For services from 10 to 500 G.P.M. with heads up to 225 Feet. Write for Catalog D2-1042 which fully describes and illustrates the SCV pump.

Free!

Economy's latest Pump Data Book. Contains a wealth of data and supplies information for the solution of most pumping problems. Written in simplified form—easily understood by anyone interested in pumps. Get your copy now—simply send your request on company's letterhead.

- Easy to install—low operating cost — minimum maintenance requirements.
- Complete rotor, including motor, can be removed without disturbing the suction and discharge connections.
- No costly shutdowns — in the event of motor failure any comparable stock motor is easily adapted.
- Impeller runs smoothly between two bearings—no shaft whip—no noise.

Economy Pumps Inc.

HAMILTON, OHIO

Dig and Haul . . . AT LOWEST COST

This 2½ cu. yd. Sauerman Drag Scraper digs deep into hill of gravel and moves 1,000 tons of material per day to crusher.

For larger profits on long range excavating and material handling work, use a Sauerman Drag Scraper, Slackline, or Tower Machine. A Sauerman machine is able to span an area 1,000 ft. or more in width and convey materials from any point in this area at a rapid rate. One man handles the entire operation.

Many different jobs—large and small—where materials have been dug, hauled and placed for a few cents per cubic yard are illustrated in the Sauerman Catalog. Write for this book.

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Specify **TRI-LOK**

OPEN STEEL FLOORING • SAFETY STEPS
CONCRETE ARMORING T. TRI-LOK

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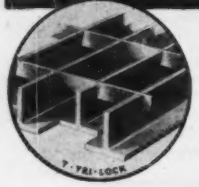
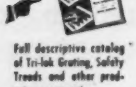




Full descriptive catalog of Tri-lok Grating, Safety Treads and other products on request.

manager for the WPA at Lincoln, Nebr., is now a member of the engineering staff of the Douglas Aircraft Corp.

Geo. P. Leonard is now a superintendent for the Martin Wunderlich Co., on the construction of the Pan-American Highway from San Isidro, Costa Rica, to David, Panama.

Baxter F. Wade has been appointed superintendent of the waterworks at Jackson, Miss.

P. R. Martin has left the St. Maurice Power Corporation, Ltd., LaTuque, Canada, to join Electric Steels Limited at Cap de la Madeleine, Quebec.

A. P. Villadsen has been promoted from assistant division engineer of the Alabama State Highway Department for the sixth district to division engineer with headquarters at Grove Hill, Ala.

B. H. Suhr, member of the firm of Suhr, Berryman, Peterson & Suhr, surveyors and engineers of Chicago, Ill., is now a Lieutenant Commander in the Navy Civil Engineer Corps.

John Cash Bridger, associate professor of civil engineering at Mississippi State College, has been commissioned a lieutenant (J.G.) in the Navy Civil Engineer Corps.

Hiram E. Bryan, who retired recently as City Engineer of Rochester, N. Y., will serve as technical consultant to the Citizens' City Planning and Housing Council, according to a recent announcement.

Lloyd G. Richey, former city engineer at Belmont, N. C., is now a lieutenant in the Corps of Engineers, stationed at Fort Bragg, N. C.

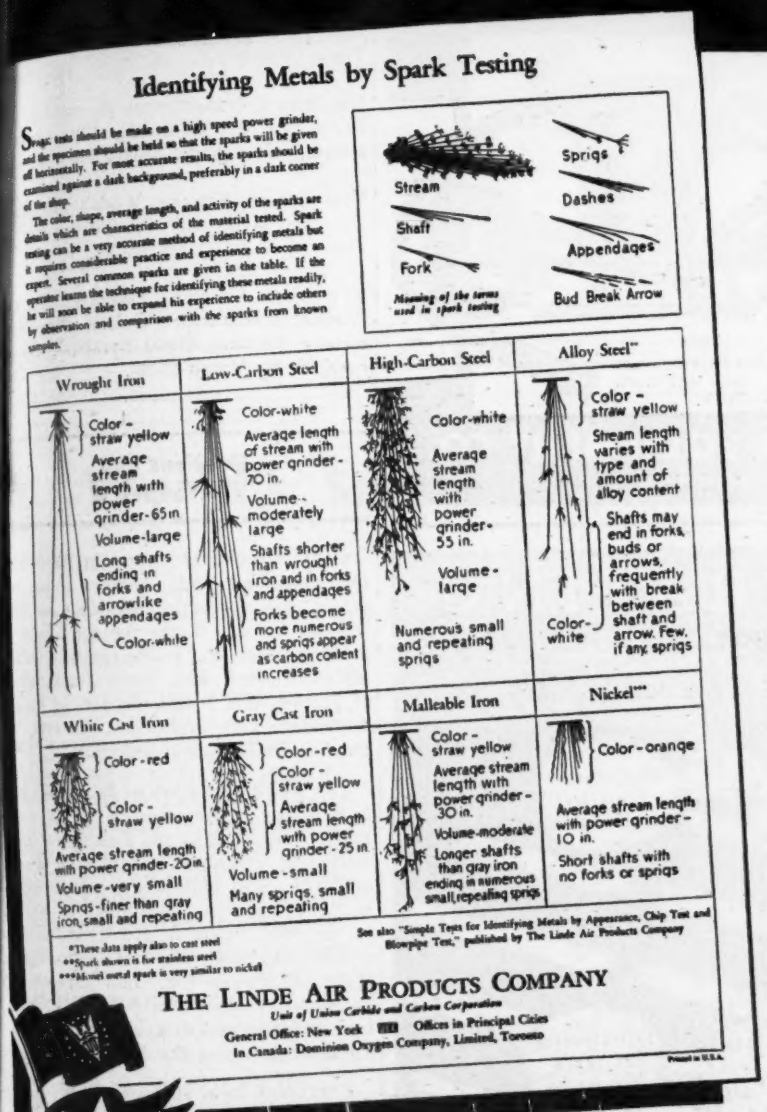
J. B. Winder, chief engineer for the Dallas, Texas, waterworks, and former superintendent of the Waterworks Department, has been loaned to the City of Houston to assist in reorganizing that municipality's water utility and increasing its efficiency.

O. H. Lowery, inspector for the Corps of Engineers, has been named to the agricultural engineering staff of the Iowa State College, replacing **R. K. Frevert,** who joined the Army last November.

Franz W. Warner of Sanford, Fla., recently has been commissioned a second lieutenant in the Corps of Engineers.

Fred M. Grant, who has served nearly four years as deputy state engineer, has been renamed to that post in the Arizona State Highway Department.

How to Identify Metals by Spark Testing . . . for More Efficient Classification and Segregation of Metal Scrap


Identifying Metals by Spark Testing
Spark tests should be made on a high speed power grinder, and the specimen should be held so that the sparks will be given off horizontally. For most accurate results, the sparks should be examined against a dark background, preferably in a dark corner of the shop.
The color, shape, average length, and activity of the sparks are details which are characteristics of the material tested. Spark testing can be a very accurate method of identifying metals but it requires considerable practice and experience to become an expert. Several common sparks are given in the table. If the operator learns the technique for identifying these metals readily, he will soon be able to expand his experience to include others by observation and comparison with the sparks from known samples.
Stream
Sprigs
Dashes
Shaft
Fork
Appendages
Meaning of the terms used in spark testing
Bud Break Arrow
Wrought Iron
Color - straw yellow
Average stream length with power grinder - 65 in.
Volume - large
Long shafts ending in forks and arrowlike appendages
Color - white
Low-Carbon Steel
Color - white
Average length of stream with power grinder - 70 in.
Volume - moderately large
Shafts shorter than wrought iron and in forks and appendages
Forks become more numerous and sprigs appear as carbon content increases
High-Carbon Steel
Color - white
Average stream length with power grinder - 55 in.
Volume - large
Numerous small and repeating sprigs
Alloy Steel**
Color - straw yellow
Stream length varies with type and amount of alloy content
Shafts may end in forks, buds or arrows, frequently with break between shaft and arrow. Few, if any, sprigs
Color - white
White Cast Iron
Color - red
Color - straw yellow
Average stream length with power grinder - 20 in.
Volume - very small
Sprigs - finer than gray iron, small and repeating
Gray Cast Iron
Color - red
Color - straw yellow
Average stream length with power grinder - 25 in.
Volume - small
Many sprigs, small and repeating
Malleable Iron
Color - straw yellow
Average stream length with power grinder - 30 in.
Volume - moderate
Longer shafts than gray iron ending in numerous small, repeating sprigs
Nickel***
Color - orange
Average stream length with power grinder - 10 in.
Short shafts with no forks or sprigs
*These data apply also to cast steel
**Spark shown is for stainless steel
***Monel metal spark is very similar to nickel
See also "Simple Tests for Identifying Metals by Appearance, Chip Test and Blowpipe Test," published by The Linde Air Products Company
THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
General Office: New York Offices in Principal Cities
In Canada: Dominion Oxygen Company, Limited, Toronto
Printed in U.S.A.

IT is important that those responsible for the collection and preparation of scrap metal know how to distinguish between different types of metal. It is particularly important to identify steels containing valuable alloys. These should be segregated so that they will not be wasted by being thrown in with ordinary, run-of-the-mill scrap. These alloy steels bring higher prices, too — often more than enough to offset the expense of classification and segregation.

How Spark Testing Will Help You

Spark testing is one of the simplest methods — yet one that is accurate — for identifying different types of metal, because each metal throws off a characteristic spark when it is held against a grinding wheel. The chart shown at the left explains the colors and illustrates the characteristic shapes of such sparks for various commonly used metals. With this chart as a guide, operators will be able to classify and segregate metal scrap quickly.

Send for Large Wall Charts

Large reprints (10½ in. by 15¼ in.) of the chart shown are available without charge from any Linde Office. *Ask for Form 4666.*

Another useful chart (15¼ in. by 22 in.) that is available from Linde Offices, without obligation, is "Simple Tests for Identifying Metals by Appearance, Chip Test, and Blowpipe Test." *Ask for Form 2299.*

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 East 42nd St., New York, N. Y. UCC Offices in Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

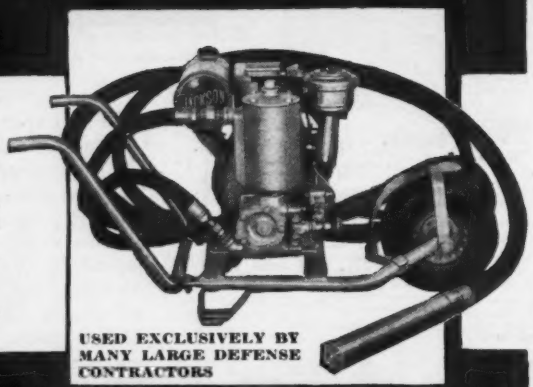
The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks.

. . . If you want to make speed profitably . . . GET DEPENDABLE EQUIPMENT . . Buy the Fast . . .

JACKSON Hydraulic Concrete Vibrator

DESIGNED TO "TAKE IT" 3 SHIFTS A DAY — EVERY DAY

- Automatic pressure lubrication—requires no attention.
- 34-ft. hose—2¾" vibrator head.
- Adjustable frequency to 6800 R.P.M.—submerged in concrete.
- Powerful gas engine—4.7 H.P.
- Long-lived, ball-bearing, rotary, hydraulic pump.



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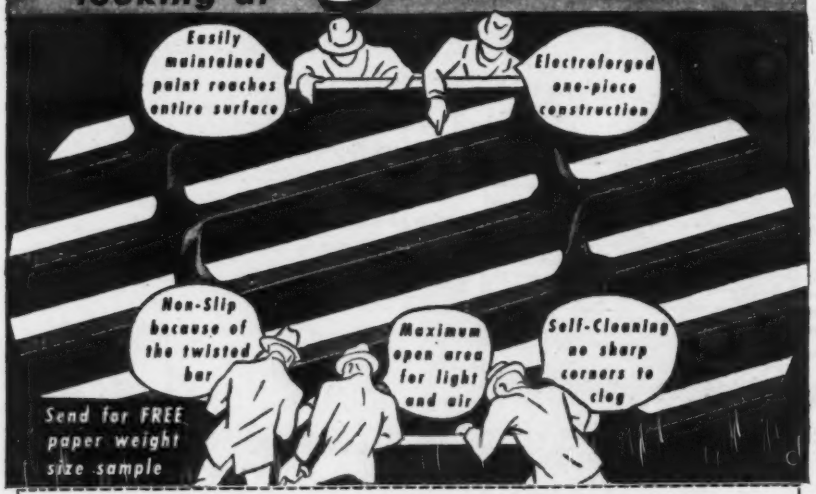
They are looking at 5 OUTSTANDING FEATURES


Easily maintained paint reaches entire surface
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Self-Cleaning no sharp corners to clog
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MEETINGS

AMERICAN SOCIETY FOR TESTING MATERIALS, spring meeting, Hotel Statler, Buffalo, N. Y., week of March 1.

REGIONAL AND LOCAL MEETINGS

UNIVERSITY OF UTAH, 4TH ANNUAL HIGHWAY CONFERENCE, Salt Lake City, March 1-2.

SOUTHERN SAFETY CONFERENCE, 5th annual meeting, Hotel Peabody, Memphis, Tenn., March 1-2.

HIGHWAY COMMISSIONERS OF THE UPPER PENINSULA OF MICHIGAN, 10th annual meeting, Houghton, Mich., Mar. 11-12.

NEW JERSEY SEWAGE WORKS ASSOCIATION, war conference, Stacy-Trent Hotel, Trenton, N. J., March 25-26.

NEW YORK SECTION, AMERICAN WATER WORKS ASSOCIATION, Spring War-Conference Meeting, Hotel Syracuse, Syracuse, N. Y., March 25-26.

Elections and Activities

CARL CARPENTER, superintendent of the Hammond, Ind., sewage plant, recently was re-elected president of the Indiana Sewage Works Association at a meeting held at Indianapolis. Other officers elected were Dave Backmeyer, of Marion, and Arthur Caster, of Camp Atterbury, vice presidents; Dwight O. Bender, Indianapolis, secretary.

THE ENGINEERS Club of Baltimore has named two representatives of a committee appointed by the Baltimore Association of Commerce to aid educational authorities and industrialists in developing and expanding vocational education in the city. Carroll F. Merriam, hydraulic engineer of the Pennsylvania Water & Power Co., and Edward B. Passano, president of the Waverly Press, Inc., and also an engineer, represent the Engineer group on the committee.

ENGINEERS from all parts of Wyoming met in Cheyenne recently for the 24th annual convention of the Wyoming Engineering Society. Owing to wartime conditions the convention was shortened to a one-day session held in the Hospitality House of the Cheyenne Light, Fuel & Power Co.

Officers named for 1943 were: Ellis Hudman, Rock Springs, president; C. F. Seifried, acting superintendent and chief engineer of the Wyoming State Highway Department, vice president, and Kirby

World's Smallest Explosive Charge

HERE'S a rivet that's making history. It's the Explosive Rivet—a new development by du Pont.

To you who shoot dynamite by the stick, case, or ton, the Explosive Rivet is of more than passing interest. It's a dramatic example of the control achieved by du Pont over the action of explosives. For this rivet is a precision product in which uniformity of results must meet the high standards required for America's finest military aircraft.

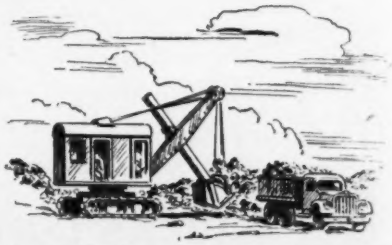
In the rivet shank there's a tiny explosives charge. It's the smallest "load" used in industry, yet the job it does in millions of Explosive Rivets speeds aircraft production.

SAVE FATS FOR EXPLOSIVES

Fats are urgently needed for making glycerin—an essential ingredient in the production of high explosives. Urge housewives to aid the war effort by taking waste fats to their butcher.

Explosive Rivets speed up "blind" riveting—that is, riveting in places where you can't reach one side of the rivet to back it up. To "drive" or set these rivets you simply apply the tip of an electrically-heated iron to the rivet head. In 2 seconds, or less, the heat fires the charge, forming a perfect, barrel-shaped head on the blind end.

At du Pont the same men, the same fund of experience, and the same laboratory facilities responsible for perfecting and manufacturing Explosive Rivets are constantly at work producing new and better commercial explosives and blasting supplies. Thus, whether your job is to bring down big, shatter-proof lump coal—to drive a tunnel through hard rock—or to quarry stone, you can count on Du Pont Explosives Research for the finest in explosives. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington, Del.



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ELECTRIC BLASTING CAPS—reliability proved by over one billion sold to date.

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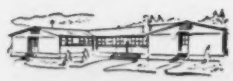
EXPLOSIVES

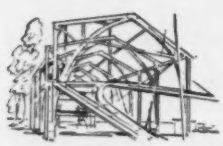
GLUE "DOOD IT" AGAIN

5 Wood & Glue Laminated Arches were used on this San Pedro Auditorium. Span 60'—Rise 30'—Spacing 18'8"



LAUCKS GLUE FOR PREFABRICATED WARTIME HOUSING

152' "STEEL-STRENGTH" BEAMS OF WOOD AND LAUCKS GLUE



LAUCKS GLUE LAMINATED ARCHES FOR ARMY CHAPEL

BUILDING this defense housing project auditorium called for speed, strength and economy.

Summerbell Roof Structures of Los Angeles, pioneers in glue laminated arches, beams and roof structures, found the answer in Laucks Glues and wood. General Contractor for the project was E. C. Nesser and William Allen and W. Geo. Lutzi were the architects.

Investigate how Laucks Construction Glues can save time, money and critical materials on *your* jobs—in laminated arches or beams, in prefabricated and all types of dry-built construction with plywood and wallboard, in farm structures, etc.

For information, write Laucks, where 20 years' laboratory research and practical experience guarantee the right use of the right glue.

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OPEN STEEL FLOORING

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90% Open Area
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Hayward Buckets

Use this Class "E" Clam Shell Bucket for handling crushed stone, gravel, sand and other bulk materials.
THE HAYWARD CO., 49-50 Church St., N. Y.

H. Olds, of Cheyenne, re-elected secretary-treasurer.

Speakers included Capt. M. B. Lidgow, U. S. Army Area Engineer; Phil A. Upp of the Wyoming state highway department; and Dr. A. G. Crane, western educator and an honorary member of the society. John A. Whiting, Sr., one of the founders of the group, presided at the afternoon session.

RAYMOND C. SCHWIND, structural engineer of Rochester, N. Y., has been elected president of the Rochester Section, American Society of Civil Engineers. Other officers elected are: Thomas Leach, first vice president; Eldred H. Walker, second vice president; Vernon E. Warney, secretary-treasurer.

T. L. MACMANAMNA, of London, England has been elected new chairman of the London Branch of the Engineering Institute of Canada, with R. S. Charles as vice chairman.

LEWIS MERRITT has been elected president of the Wilmington, N. C., Engineers Club.

THE 1943 annual meeting of the Association of Professional Engineers of Nova Scotia was held in the Nova Scotia Technical College at Halifax, N. S. A. E. Cameron, Halifax, was elected president; J. M. Jones, Liverpool, vice president; S. W. Gray, Halifax, secretary-treasurer.

THE FIFTH annual Southern Safety Conference will be held at Memphis, Tenn., March 1-2.

R. H. FIELD of Ottawa has been elected president of the Canadian Institute of Surveying, succeeding C. H. Fullerton, of Toronto.

A. E. BOUNSAK, Kenosha, Wis., was elected president of the Wisconsin Road Builders Association at its 30th annual convention held recently in Milwaukee. N. M. Issabella, of Madison, was elected vice president; Milo Cape, of Racine, treasurer; Claire Pierce, Eau Claire, secretary; Duane Hoffman and J. A. Gallagher, Madison, directors. At the meeting the association affirmed its stand in opposition to the diversion of highway funds.

AT ITS ANNUAL meeting of the Association of Professional Engineers of New Brunswick, held at St. John, N. B., E. I. Turner of the faculty of the school of engineering of the University of New Brunswick, was elected president. J. T. Turnbull, of Red Head, was named vice president, and D. R. Smith, of St. John, chairman of the board.

BOOM OPERATION PLUS HOISTING WHILE SWINGING *Saves Time...*

It's no joking matter this idea of getting the scrap in the scrap. It's a must for '43. Even the boys on the battlefield have special salvage units which lug the scrap metal away from the combat areas. And the war isn't held up while they do it . . . bombs fly . . . bullets whiz by . . . shells burst in air . . . as they hurry the scrap back to the mills to make a new fighting unit. Our soldiers know how vital this scrap is in attaining VICTORY. So let's all get our scrap into the scrap today. Casualties will be cut in two . . . scrap piles will swell . . . and Koehring Cranes will help speed up a victory with its boom operation plus hoisting while swinging.

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Serving the "FACTORY FRONT" too!

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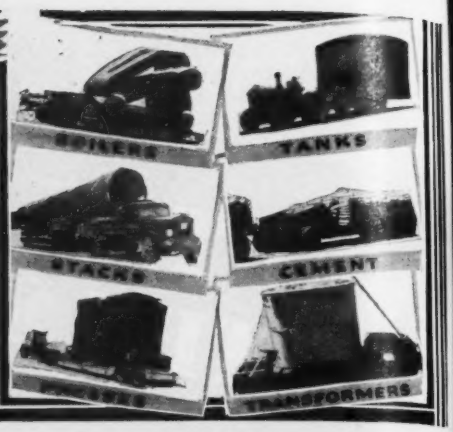

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LIKE submarines that cruise beneath the surface, Owen Dredging Buckets embody special and highly efficient features to protect against the uncommon difficulties encountered in this severe service . . . special protection against water, sand, grit, etc.

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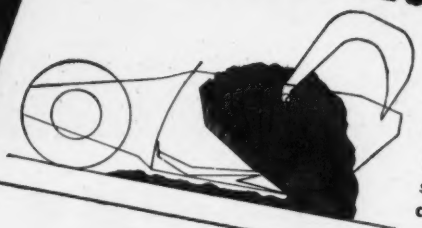
Here's Why HEIL CABLE SCRAPERS Unload Faster and Cleaner with less cable pull

...TILTING FLOOR PUSH-OUT



About a third of the load rolls out by gravity, through high-opening front apron. Balance is ejected by moving the tilting floor upward and forward. Hinged tilting floor scrapes sides of bowl clean, hinged section at rear scrapes back sheet clean. Dirt has no chance to stick.

The unloading operation of a Heil Cable Scraper is a honey to watch. Your operator drives onto the fill at hauling speed — without the necessity of shifting gears, because the low line pull required to work the tilting floor does not stall the tractor motor. He spreads *all* the load smoothly and evenly at high speed — with no sticking in the bowl, even in wet, sticky soils... Such performance is possible only because Heil engineers have done a thorough job of designing a big-capacity cable scoop for speed, flexibility, and scientific weight distribution—to help you get bigger yardage at lower cost, along with a reputation as a successful operator... Use Heil dirt moving equipment, for maximum yardage per hour and maximum productive hours on the job; through easier maintenance, longer life, and simpler field repairs. Write for bulletins describing other Heil design features such as correct bowl design, scientifically located draft-pivot point, fulcrum-type lift, all-welded construction, etc., etc.

View of empty bowl, showing tilting floor in practically vertical position at the end of the unload cycle.

TILTING A LOAD REQUIRES LESS EFFORT THAN PUSHING IT

It requires less power to raise and dump a load than to slide it forward against friction. Tilting also gives greatest leverage at the start of the unloading cycle, when the load is heaviest—and a speed-up as the load is dumped, maintaining an even discharge.

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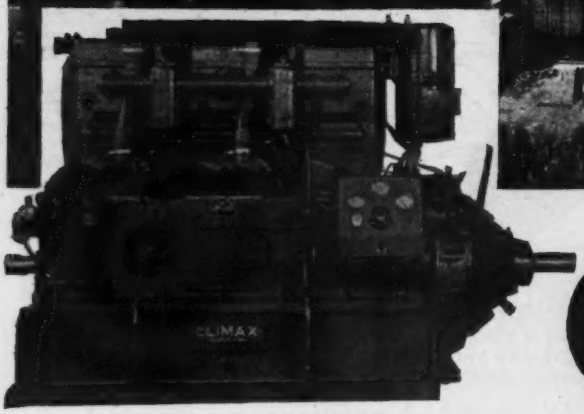

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Engines—4, 6, 8 and 12 cylinders, 4 cycle . . . rating 8 to 435 hp., using natural gas, butane and gasoline.

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Among the many applications for Climax Engines and Generating Sets are the following:

Excavating	Snow Plows
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For self-contained, dependable gas or electric power, specify Climax Gas Engines and Climax Generating Sets. These units enable you to take your power with you, eliminate all dependence on purchased power, and save you money. Here are two of their many advantages . . .

Flexibility

As is well known, engines burning only one fuel lack the flexibility of gas engines designed to run on a variety of fuels. Moreover, the simple construction of gas engines permits them to be maintained by the average field mechanic. No specially trained service men are needed.

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The simple, well balanced design provides high mechanical efficiency, and the heavy, reinforced construction insures many years of profitable service. In fact, some of the Climax Engines built nearly 30 years ago are still in service. Among the construction superiorities available are:

1—Dual Carburetion for most effective fuel distribution and smoothest operation.

2—Dual Magneto Ignition with Dual Spark Plugs provides highest power output and smoothest operation.

3—Efficiently adaptable to belt or chain driven equipment, or can be direct connected. For the latter, Climax will furnish complete equipment —engine, pump, planer, generator or other machinery — mounted as a complete unit. If required, it may be fully enclosed for portable or stationary use.

Get the details now on how Climax Engines or Generating Sets can meet your particular requirements. Give the nature of your local fuels, load characteristics, horsepower requirements and other particulars. With this information, Climax can build you a prime mover "tailored" and equipped to do your job dependably and economically. Write to address below — Department S.

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